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Electronics

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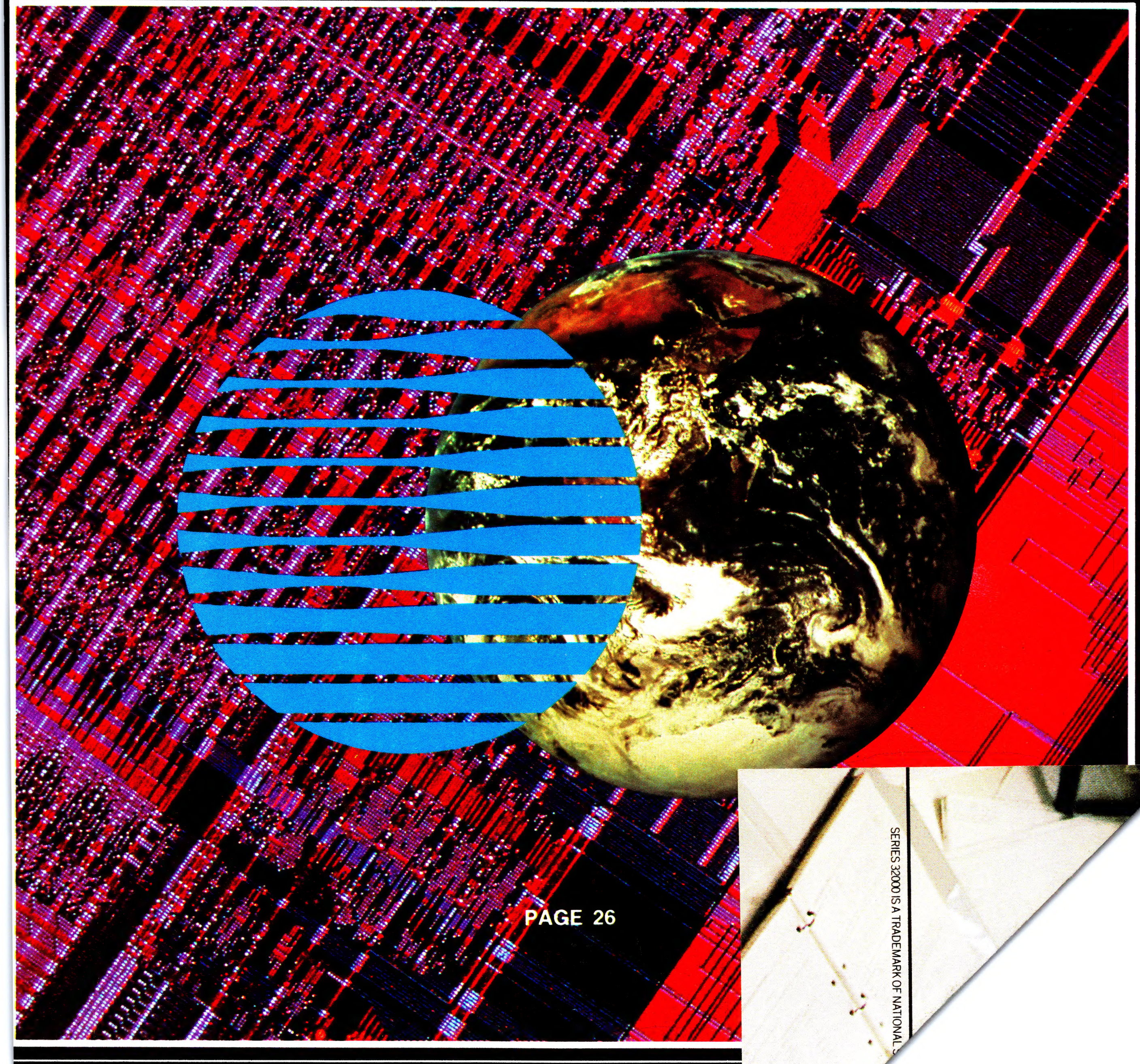
THE WORLDWIDE TECHNOLOGY WEEKLY

AUGUST 5, 1985

AT&T'S GLOBAL PLAN TO SCORE IN COMPUTERS



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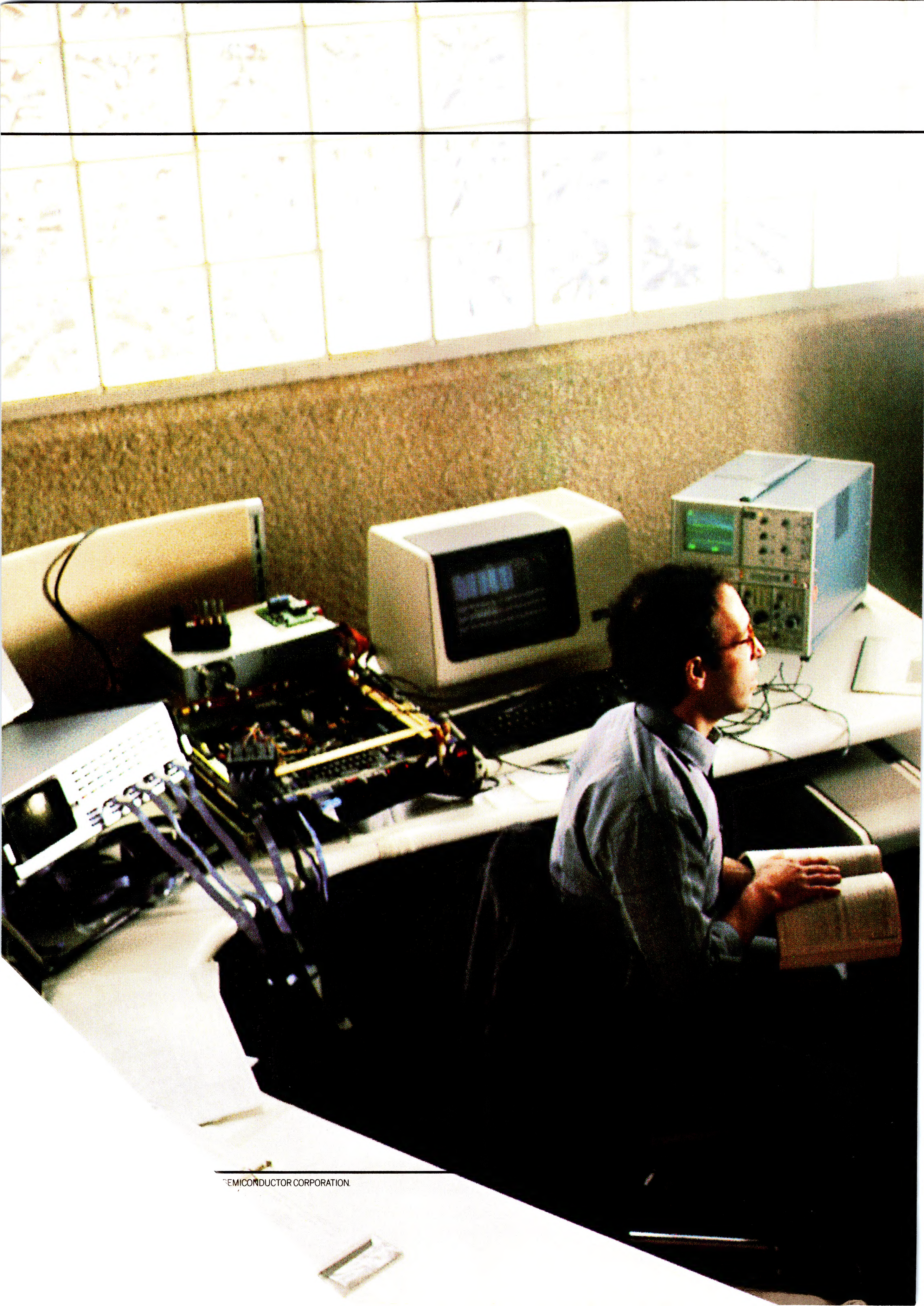
SMART POWER MOVES FROM PROMISE

A VLSI TESTER THAT TESTS

SERIES 32000 IS A TRADEMARK OF NATIONAL S



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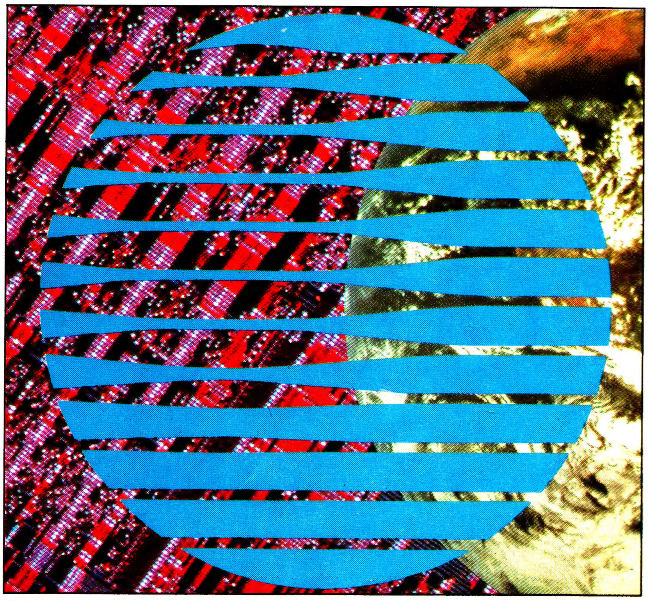
Electronics

PROBING THE NEWS



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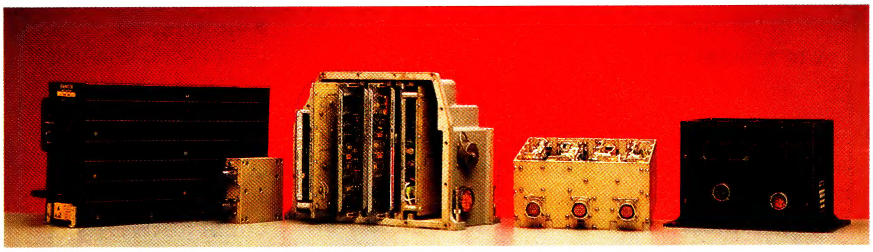

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PUBLISHER'S LETTER

AT&T Co. has charted a course into the computer business, long the domain of IBM Corp. IBM, for its part, has dropped anchor in the telecommunications business, AT&T's stronghold. When leviathans like these start encroaching on each other's territory, the call to battle stations is bound to sound.

To find out what sort of artillery AT&T intends to roll out in the confrontation, our business editor, Bob Kozma, talked to computer executives at AT&T and some of the analysts that follow the company's fortunes. And to ferret out some clues on what IBM might have in mind as a counterattack, our Chicago correspondent, Wes Iversen, attended a seminar on the future of IBM that was held by the Gartner Group as a windup to the mid-July National Computer Conference there.

After his round of interviews, Kozma found that not many people know what AT&T is doing in computers, now that it has been separated from its former telephone operating companies for a year and a half. "Some wags say that even the company itself doesn't know," he says. "Selling computers is a lot different from selling telephones, as any number of companies will tell you," Bob says dryly.

His story on how AT&T intends to live with that difference starts on p. 26; Iversen's report on the Gartner Group's seminar follows.

INFORMED. Wes Iversen attended a two-day seminar for his piece on the future of IBM.

Wes (photo) found the seminar so absorbing that he filled about one and a half legal-size yellow pads with notes—"a lot more good information than I could ever hope to put in one story," he says. He reports that among the 460 people from 185 or so companies that turned up at the seminar, the nine representatives from AT&T formed the largest delegation.

After sifting through his voluminous notes, Wes decided to focus his piece by basing it on the keynote address from Gartner Group vice president Steve Cohen, himself an IBM veteran.

"It provided a good broad overview of how the consulting outfit sees IBM's future. Judging from Cohen's remarks, it looks as if things are only going to get tougher for IBM's competitors in many of the hardware businesses. And given the pressure for growth and profitability, don't be surprised to see IBM jumping into new market niches—even relatively small niches—if the development costs are relatively low and the potential for return is good."

Laurence Altman

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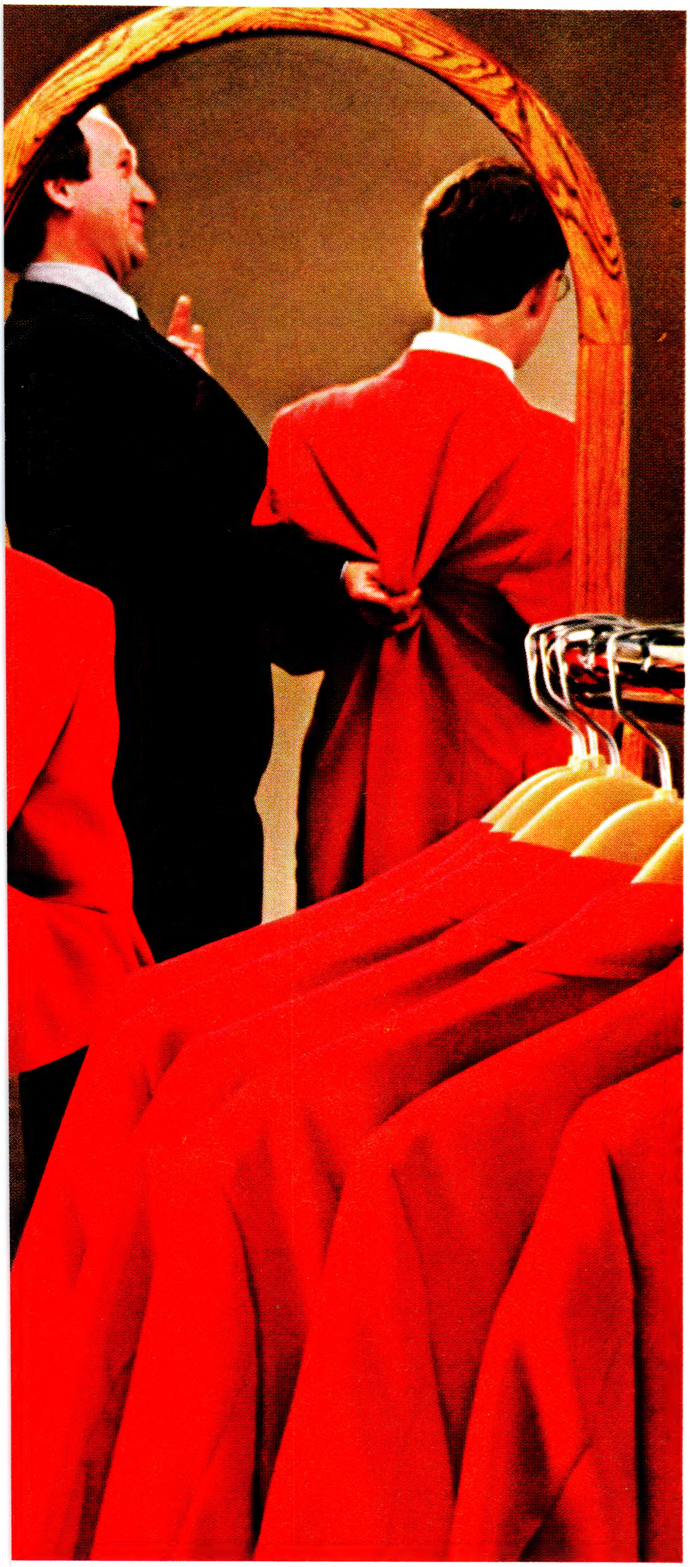

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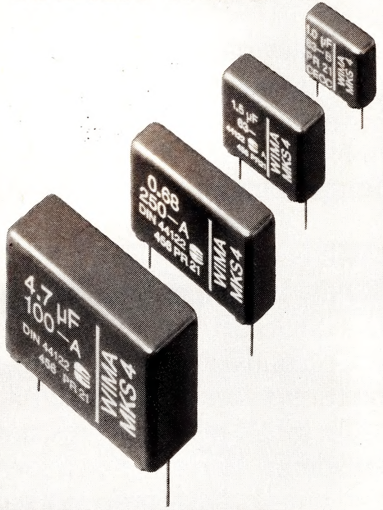

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MEETINGS

ISC Expo East '85: International Security Conference and Exposition, Cahners Exposition Group (1350 E. Touhy Ave., Des Plaines, Ill. 60018), New York Coliseum and Hilton Hotel, New York, Aug. 27-29.

Byte Computer Shows, The Interface Group Inc. and *Byte* magazine (The Interface Group, 300 First Ave., Needham, Mass. 02194), Convention Center, Dallas, Sept. 5-7; New York Coliseum, New York, Sept. 19-21; Brooks Hall, San Francisco, Sept. 26-29.

Controls West: International Industrial Controls Conference and Exposition, Tower Conference Management Co. (331 W. Wesley St., Wheaton, Ill. 60187), Convention Center, Long Beach, Sept. 16-18.

Semicon/East '85, Semiconductor Equipment and Materials Institute Inc. (625 Ellis St., Suite 212, Mountain View, Calif. 94043), Bayside Exposition Center, Boston, Sept. 17-19.

Videotex Europe—Basel '85, International Videotex Industry Association (Sekretariat Vtx 85, Swiss Industries Fair, Postfach CH-4021, Basel, Switzerland), European World Trade and Convention Center, Basel, Sept. 17-19.

Unix Expo, National Expositions Co. (Robert P. Birkfeld, National Expositions, 14 W. 40th St., New York, N. Y. 10018), New York Hilton and Sheraton Centre, New York, Sept. 18-20.

CAMP '85: the European Conference and Exposition on Computer Graphics, World Computer Graphics Association Inc. (2033 M St., N. W., Suite 399, Washington, D. C., 20036), International Congress Center, Berlin, Sept. 24-27.

MCSC '85: Mobile Communications Show and Conference, EIA (Jack Wayman, EIA, 2001 Eye St., N. W., Washington, D. C. 20006), Convention Center, Washington, Sept. 26-28.

31st IEEE-Holm Conference on Electrical Contacts, IEEE (345 E. 47th St., New York, N. Y. 10017), Palmer House, Chicago, Sept. 30-Oct. 2.

4th National Conference on Environmental Stress Screening of Electronic Hardware, Institute of Environmental Sciences (940 E. Northwest Hwy., Mount Prospect, Ill. 60056), Hyatt House, San Jose, Calif., Sept. 30-Oct. 3.

17th Electrical/Electronics Insulation Conference, International Coil Winding Association Inc. (P. O. Box 35395, Minneapolis, Minn. 55435), Sheraton Hotel, Boston, Sept. 30-Oct. 3.

Expo SMT, Surface Mount Technology Association (P. O. Box 1869, Los Gatos, Calif. 95031), Tropicana Hotel, Las Vegas, Nev., Oct. 1-3.

Technology Opportunity Conference: First International Conference in Japan on Optical Memory Technology, Rothchild Consultants and Usaco Corp. (Technology Opportunity Conference, P. O. Box 14817, San Francisco, Calif. 94114-0817), Keidanren Kaikan, Tokyo, Oct. 2-4.

Electronic Displays '85, Network Events Ltd (Printers Mews, Market Hill, Buckingham, MK18 1JX, England), Exhibition Centre, Frankfurt, West Germany, Oct. 2-4.

Telecommunications Deregulation, The Energy Bureau Inc. (41 E. 42nd St., New York, N. Y. 10017), Sheraton Crystal City, Arlington, Va., Oct. 7-8.

10th Conference on Local Networks, IEEE (10th Conference on Local Networks, c/o Dan E. Gahlon, General Chairman, Interactive Systems/3M, 225-4S-06 3M Center, St. Paul, Minn. 55144), Minneapolis, Oct. 7-9.

Electronicom '85: the International Electrical, Electronics Conference and Exposition, Canadian Region of the IEEE (Don Gerrior, CRIEEE, 1450 Don Mills Rd., Ontario M3B 2X7, Canada), Metro Toronto Convention Centre, Toronto, Oct. 7-9.

1985 National Communications Forum, National Engineering Consortium (Robert M. Janowiak, National Communications Forum, 505 N. Lake Shore Dr., Suite 4808, Chicago, Ill. 60611), Ramada Hotel O'Hare, Des Plaines, Ill. Oct. 7-9.

ICCD '85: International Conference on Computer Design, IEEE (ICCD '85, P. O. Box 639, Silver Spring, Md. 20901), Rye Town Hilton, Port Chester, N. Y., Oct. 7-10.

Electronic Imaging '85: International Electronic Imaging Exposition and Conference, Society of Photographic Scientists and Engineers and Electronic Imaging (Robert B. Entwistle, Institute for Graphic Communication Inc., 375 Commonwealth Ave., Boston, Mass. 02115), Sheraton-Boston Hotel, Boston, Oct. 8-10.

Internepcon: International Electronic Packaging and Production Equipment Conference and Exposition, British Information Services, (845 Third Ave., New York, N. Y. 10022), Metropole Exhibition Centre and Brighton Centre, Brighton, UK, Oct. 8-10.

Software & Applications Conference, IEEE (IEEE Computer Society, Administrative Office, P. O. Box 639, Silver Springs, Md. 20901), Americana Congress Hotel, Chicago, Oct. 9-11.

THIS Electronics WEEK

THURSDAY July 25

British Telecom International, AT&T, and Texas Instruments signed an accord today in New York under which **TI will get a direct satellite link for communication with its primary European communications hub in Bedford, England.** British Telecom will provide a dish in Britain, while AT&T Co. will do the honors in the U. S. The link will be capable of data-transfer rates of up to 768 kb/s, the companies said. It marks the first time either has provided a dedicated dish as opposed to the more common shared community or "urban gateway" dishes provided by both AT&T and British Telecom.

FRIDAY July 26

Texas Instruments Inc. suffered a $3.9 million loss for the second quarter ended June 30. TI's net billings were down 16% from a year ago, when the Dallas chip maker showed an $85.9 million net gain on sales of $1.4 billion.

MONDAY July 29

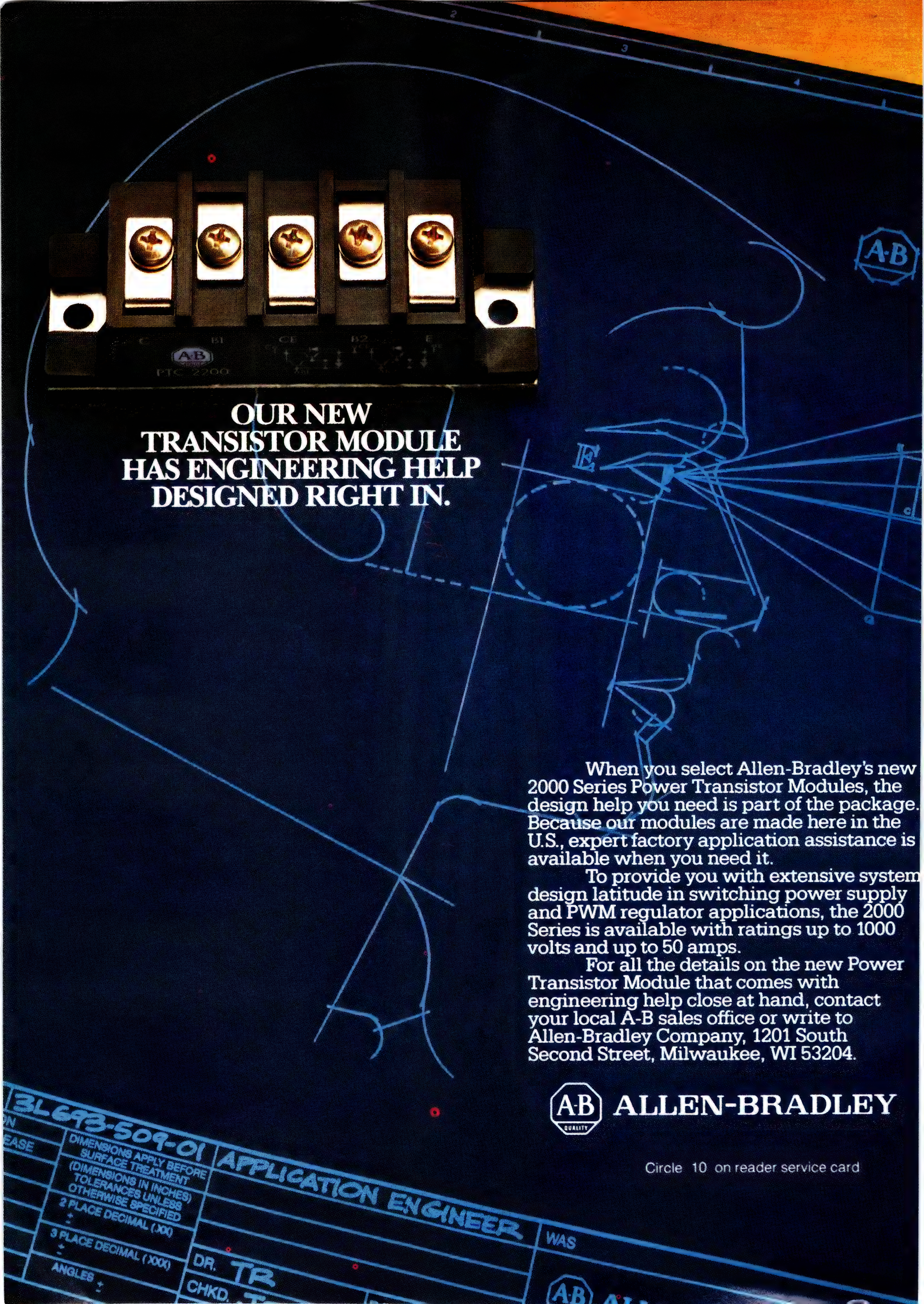
In an effort to gain much-needed capital, **Control Data Corp. sold its world headquarters facilities in Minneapolis for $62 million.** Under an agreement with United Trust Fund, a real-estate investment banking firm in Miami, Control Data will lease back the facilities, which consist of 1.1 million square feet of office space and 55 acres of land.

TUESDAY July 30

AT&T Co. and Ricoh Co. have formed a joint venture to market AT&T's telephone systems in Japan. The new company, called AT&T Ricoh Co. Ltd., Tokyo, will be owned 51% by AT&T and will sell a small telephone system called the R series, which will support four outside lines and 10 stations. The system will be made initially at a Ricoh facility in Japan, where it will be marketed exclusively. The agreement marks the second time in a month that AT&T has formed a joint venture company with a Japanese company, having previously formed Japan ENS Corp. to sell value-added-network facilities. . . . **Xerox Corp. said its second-quarter profits for continuing operations rose 35% to $118 million** for the period ended June 30. Xerox attributed the lion's share of the gain to growth in its Financial Services Division, which lost $6 million in the same period a year ago but showed a $16 million gain this quarter. The sale of three of the Stamford, Conn., company's publishing units, which went up for sale in April, brought in an additional $95 million, the company said (see related story, p. 26).

WEDNESDAY July 31

Information Handling Services said it will offer some of its data-base services on optical disks, or compact-disk read-only memory, beginning next spring. The data-base service company provides about 400 data bases on microfilm to a user base of about 8,000 subscribers. Users will need an IBM Corp. Personal Computer AT or XT equipped with a compact-disk drive, a unit similar to audio CD players. Initially, the only product available will be the company's Tech Data index, a listing of electronic parts catalogs that design engineers can use to find products such as memories or gate arrays: they enter the desired specifications into their terminals. But the Englewood, Colo., company said other products will be on disk beginning in the fourth quarter of 1986. Each disk can hold the equivalent of 4,000 images—the same as a microfilm cassette—or up to 550 megabytes of information. ☐



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A-B ALLEN-BRADLEY

Circle 10 on reader service card

ELECTRONICS NEWSLETTER

A NEW BILL WOULD HALT IMPORTS USING PATENTED U. S. PROCESSES

New legislation has been introduced to stop "the free ride that foreigners take on U. S. R&D expenditures." A bill introduced by senators Walter Mathias (R., Md.) and Frank Lautenberg (D., N. J.) would make it a violation of patent law to import any product made overseas that uses an unlicensed patented U. S. process. One company that would benefit immediately from such a law is Corning Glass Works. The Corning, N. Y., company has tried unsuccessfully to get an International Trade Commission injunction to stop Sumitomo Electric Research Triangle Inc. of North Carolina from importing optical waveguide fibers that Corning alleges are made with its patented process. The U. S. plant is importing the fibers from its parent in Japan, Sumitomo Electric Industries Ltd. If the law is passed, Corning could sue Sumitomo for patent infringement instead of seeking remedy from the ITC, which demands proof of material injury to a domestic industry before issuing an exclusion order. Officials at Sumitomo Electric Research deny that Sumitomo is using Corning's process [*ElectronicsWeek*, Aug. 27, 1984, p. 22]; they claim that the company uses its own process. ☐

INTEL WILL START NEW BUSINESS UNIT FOR APPLICATION-SPECIFIC ICs

The Intel Corp., which has been dabbling in the application-specific integrated-circuit business for three years with foundry and second-sourcing operations, has decided to move into ASICs on a large scale. Jack C. Carsten, a senior group vice president, will head an entirely new ASIC business unit, reporting to Intel president Andrew S. Grove. The Santa Clara, Calif., firm expects ASICs to account for as much as 20% to 30% of its business within five years. Carsten's current responsibilities with the components group will be divided among several other executives. The reorganization will take a couple of months to complete. ☐

NASA THINKS ABOUT PUTTING ADA IN ORBIT

Ada may soon become the official language of on-board software for the National Aeronautics and Space Administration's Space Station Project. NASA likes the Defense Department's programming language because it can manage the type of massive software development required by space missions. The Space Station Control Board at the Johnson Space Center in Houston might announce its verdict on Ada by Aug. 16, according to Barbara Putney, software manager for the Space Station Project.

Both Putney and Marion Pringle, acting manager of data-management systems for the Space Station Project, assert that Ada's nomination for the official Space Station language does not mean NASA's ties to the department are tightening. "There has been no interaction with or influence by the DOD on this point," claims Putney. ☐

IBM KEEPS TO INTERFACE AGREEMENT WITH EUROPEAN COMMISSION

IBM Corp. is complying with an out-of-court agreement reached last year regarding an unfair-practices suit that the European Commission brought against the big computer maker [*ElectronicsWeek*, Aug. 13, 1984, p. 20]. The commission is satisfied that IBM is carrying out the terms of the agreement with "cooperation and efficiency," according to Peter Sutherland, EC commissioner for competition. Among other things, the agreement requires IBM to provide information to competitors about interfaces between System/370 equipment and software within 120 days of relevant product announcements. IBM also agreed to give details of products that enhance its Systems Network Architecture. ☐

ELECTRONICS NEWSLETTER

HITACHI WILL SPEND ANOTHER $120 MILLION IN THE U. S. TO EASE TENSIONS

Responding to the "current emergency in trade tensions," Japan's Hitachi Ltd. says it is sending an import promotion team to the U. S. to spend $120 million on American electronic components and equipment between now and December 1986. The purchases, which would be on top of the $260 million it has already budgeted for this year, are part of a threefold initiative that includes stepped-up capital investment in the U. S. and the establishment of the Hitachi Foundation to support cultural and educational exchanges between the U. S. and Japan. Hitachi has come under sharp criticism lately by the U. S. semiconductor industry for the so-called 10% memo [*Electronics*, June 24, 1985, p. 24], in which the Tokyo company told its sales force to always quote a figure 10% lower than the competition's price. Toshi Kitamura, Hitachi's executive managing director of international operations, referred to the memo as "promotional hype" written by an "excessively enthusiastic" U. S. employee. ☐

IBM NEGOTIATES DEAL FOR PACKAGE OF JAPANESE PATENTS

IBM Corp. is in the final stages of negotiating a license for a package of about 500 data-processing-related patents owned by the Japanese government. A spokesman for the Ministry of International Trade and Industry says that the pact will also cover patents in the communications and semiconductor areas of data processing. He expects a contract to be signed in September. These patents, which are managed by the Agency of Industrial Science and Technology, are granted for inventions at government laboratories and at companies involved with large government projects and government-contract research.

The Japan Industrial Technology Association, which usually licenses individual patents to Japanese and foreign firms, is carrying out the negotiations. Red tape would make it prohibitive to individually license the number of patents IBM wants, but officials say that no other company has ever asked for a package deal. IBM reportedly started negotiations four years ago. ☐

DEC WILL BUILD AN ADVANCED SEMICONDUCTOR PLANT IN SCOTLAND

Bucking the industry's gloom and doom, Digital Equipment Corp., the world's second-largest computer company, will invest $117 million over the next three years in a semiconductor design and manufacturing plant to be located near Edinburgh, Scotland. Scheduled to come on stream in 1988, the plant will be equipped to fabricate 6-in. wafers using a two-layer metal CMOS process. It will produce proprietary circuits including high-speed communications chips and central processing units. The plant will employ 400 workers. Most of the chips will be shipped to DEC's nearby Ayr plant for packaging, assembly into printed-circuit boards, and eventual incorporation into computers. DEC's only other semiconductor plant is in Hudson, Mass. ☐

TROUBLED DRI TO GET HELP FROM MOTOROLA AND NORTHERN TELECOM

Digital Research Inc., the trouble-plagued Monterey, Calif., developer of microcomputer software, has attracted an infusion of capital from two electronics giants. Northern Telecom Inc., a Nashville subsidiary of Northern Telecom Ltd. of Canada, will buy a 15% share of DRI for $6 million; and Motorola Inc., of Schaumburg, Ill., will pick up a 7.5% interest for $3 million. DRI, which expects a drop in revenues in the current fiscal year to $40 million, compared to $55 million in fiscal 1984, will use the new capital to promote its GEM graphics software and Concurrent DOS operating system. It has had long-term OEM arangements with both its new partners. ☐

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Electronics

ACORN GOES TO MARKET WITH RISC MICROPROCESSOR

The British company ships samples of what could be the first commercial RISC chip

CAMBRIDGE, ENGLAND

It has taken a four-man team at Acorn Computers Ltd. just 18 months to develop a 32-bit single-chip microprocessor that executes 3 million instructions/s. Using a reduced-instruction-set-computer architecture to gain performance, Acorn's ARM chip (for Acorn RISC machine) is arguably the industry's first commercial RISC microprocessor.

Acorn is offering the ARM chip on an evaluation board that runs as a second processor linked to its Model B personal computer. Limited samples of this board are available for about $2,000.

Inmos International plc, London, whose transputer chip is also based on a RISC architecture, expects to ship evaluation boards later this year.

Pioneered at Stanford University, the University of California at Berkeley, and IBM Corp.'s Thomas J. Watson Research Center, RISC machines—like race cars—are stripped to the bare essentials and their critical subsystems tuned for high performance. The ARM chip's equivalents of a race car's engine and carburetion system are a pipelined central processing unit and a memory-to-processor port with an exceptionally high bandwidth.

The ARM processor comprises an arithmetic-logic unit, a barrel shifter to assist register operations, and a bank of 25 registers, each 32 bits wide. Acorn tunes the very large-scale integrated circuit for performance in several ways.

First, Acorn hardwires the instruction set, which consists of five basic instruction types, each with an associated condition code. Microprogramming, used in most conventional processors, works by interpreting high-level instructions as a series of microinstructions held in read-only memory. Because this takes several lookup operations, microprogrammed instructions take several cycles. The ARM processor, however, executes any instruction in a single 150-ns clock cycle.

By pipelining, all parts of the processor and memory system can be used every cycle when executing consecutive register-to-register instructions. This means that in any clock cycle, one instruction could control the data path while a second is being decoded for the following cycle and a third is being fetched from memory.

The ARM has a 26-bit address bus and a 32-bit data bus so that it can achieve an 18-megabyte/s memory bandwidth. In comparison, the Digital Equipment Corp. VAX-11/750 and the National Semiconductor Corp. 32016 both offer 4-megabyte/s bandwidths. The ARM has an optional page mode that can increase data-transfer rates another 30%.

Besides being faster than microprocessors of conventional architecture, RISC chips are smaller and thus cheaper to design and make. "We get better performance than a Motorola or Zilog with about one tenth the number of components and a much smaller chip," says Steve Furber, senior designer at Acorn's Business Division.

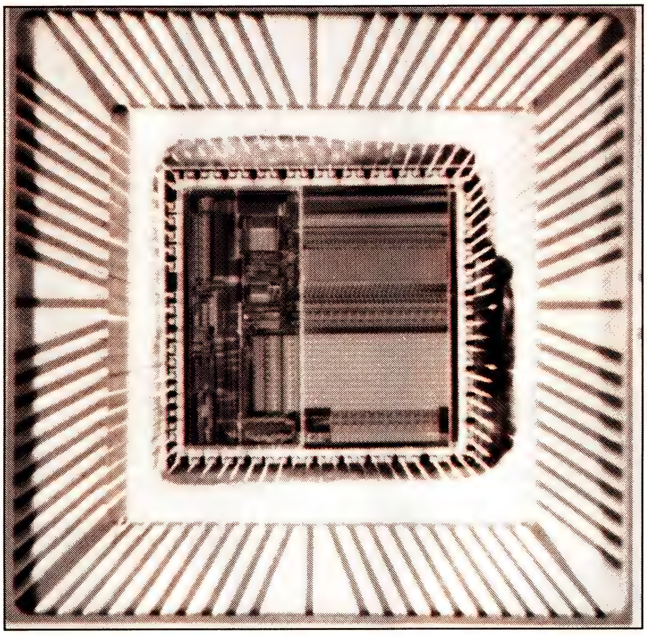
The division's VLSI design team created the ARM chip using software tools provided by VLSI Technology Inc., San Jose, Calif., and fabricated it in that company's low-power 3-μm double-layer-metal CMOS process. The setup delivered first-time-right silicon in April.

The ARM chip packs 25,000 transistors onto a small 50-mm^2 chip. In contrast, Motorola packed about 192,000 devices onto an 80-mm^2 chip using 2-μm design rules to build the 2.5-mips 68020 microprocessor. Acorn's smaller chip improves yields and lowers chip costs by about a factor of four. The company plans a further reduction to 2-μm design rules, which could increase the cost advantage over conventional processors by a full order of magnitude. Acorn expects to sell the chip in volume for about one third the price of equivalent 32-bit products.

OUTSTANDING PERFORMANCE. The ARM processor on the evaluation board transforms the $300 to $400 Model B computer into a professional work station of eye-opening performance. The 6502-based Model B connects to the ARM processor through a high-speed data channel called a tube [*Electronics*, April 5, 1984, p. 74]. The Model B takes care of all input/output, display-memory, and filing-system tasks, leaving the second processor free to handle application programs, possibly running an entirely different operating system.

The second processor is a compact, four-layer printed-circuit board carrying an ARM processor in an 84-pin Jedec type-B package; it also contains 1 megabyte of dynamic random-access memory and a bootstrap ROM. Software furnished with the board includes a simple operating system, a multiple-window text editor, compilers for the BCPL and Modula 2 languages, and a Lisp interpreter. Compilers for C, Pascal, and Fortran, together with a version of Prolog, are expected to be completed later this year.

The ARM microprocessor



IN SILICON. The ARM chip, for the Acorn RISC machine, saw light in April as first-time-right silicon, thanks to computer-aided-design tools.

works at about twice the speed of a VAX-11/780 when running compiled code, says Furber, referring to a raft of benchmark tests. For example, a set of Basic benchmark programs provided by the British magazine *Personal Computer World* takes Acorn's two-processor system just 0.7 s to complete. Running the same programs, the IBM Personal Computer took 17.6 s, the PC AT finished in 7.11 s, Apple Computer Inc.'s Macintosh took 12.15 s, and Acorn's unaided Model B was done in 14.5 s.

COMPILED SPEED. Another set of benchmarks developed by Martin Richards of Cambridge University to test compiler efficiency put the ARM processor at roughly four times the speed of a VAX-11/750 or a National 32016. Running Lisp programs, Acorn says its two-processor system is as fast as the Symbolics Inc. 3670 work station.

Acorn designed the ARM chip to support high-level languages and real-time applications in personal computers. The company expects interest from academic, government, and industrial research establishments that need high-performance engines, particularly in real-time, artificial-intelligence, or high-level-language applications. The processors required by Britain's Alvey fifth-generation-computer project, for example, represent a possible use for the chip.

The chip is about twice as fast as a VAX-11/780

The ARM chip will also form the basis for a new family of Acorn products, but at present the company will not say what those might be. Instead it wants to exploit its lead by collaborating with other companies on developing products. Now that Acorn is a subsidiary of the Italian office-equipment supplier Ing. C. Olivetti & C. SpA, it may not have to look too far for a first customer.

AT&T Co., which has established a connection with Olivetti, could well take an interest in the Acorn processor. And chip maker VLSI Technology could be interested in packaging the microprocessor for separate sale. Acorn has no intention of reentering the U.S. market on its own.

Several other companies are running on the same track as Acorn. Commercial RISC machines built with standard chips have already surfaced [*Electronics*, July 15, 1985, p. 54]. And Inmos's transputer is a chip-level RISC processor that executes the instructions of the Occam high-level language devised for concurrent programming. It is also possible that the research groups that started the RISC bandwagon rolling might in time find a way to bring one or more of their designs to market. *–Kevin Smith*

BUSINESS

SOME OBSERVERS SEE END OF IC SLIDE

PALO ALTO

Semiconductor makers are giving their already tight belts another hard tug in anticipation of third-quarter billings that will reflect nearly a year of depressed bookings. "There will be a bloodbath of red ink," says one marketing executive with resignation. But some industry analysts see the first hints that the semiconductor slide might finally have hit bottom.

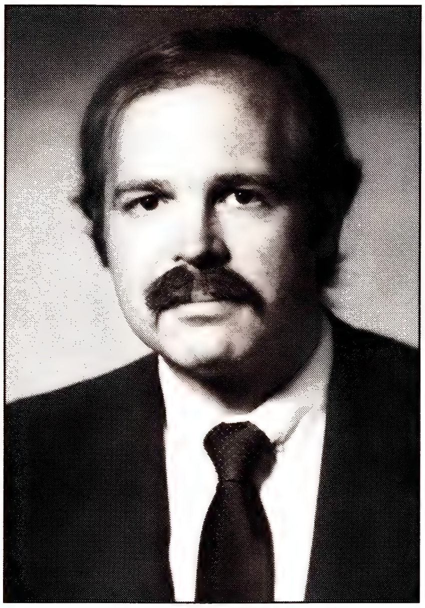
Most optimistic of all is Adam Cuhney, vice president of research at investment banking company Kidder, Peabody & Co., New York. Cuhney says his econometric model of the semiconductor industry predicts an upturn beginning in the fourth quarter of this year, based on reduced inventories for equipment makers and a small increase in the gross national product.

Support for this view comes from Charles M. Clough, president of the Wyle Laboratories Electronic Marketing Group, an Irvine, Calif., distributor. "We are seeing an important upswing in the third quarter," Clough maintains. Wyle's book-to-bill ratio stood at 1 : 1 for the second quarter, the first positive figure in a year, and should be up 10% to 15% in the third quarter, he adds.

After a year in the doldrums, bookings for custom and application-specific integrated circuits tripled in the second quarter at Silicon Systems Inc., Tustin, Calif. Based on that, "We believe we are seeing the start of a recovery," says president Carmine J. Santoro.

But even three swallows don't make a summer. Though some major semiconductor makers report an end to cancellations and an upturn in bookings, no one is ready to start cheering. Two of the giants, Texas Instruments Inc. and National Semiconductor Corp., are downright gloomy.

TI sounded the deepest note of pessimism in reporting second-quarter losses of $3.9 million. The current recession is "possibly the worst in the history of the industry," according to the TI report. A company representative predicts that the chip business will probably worsen in the third quarter.



OPTIMIST. Adam Cuhney of Kidder, Peabody & Co. says falling equipment inventories and a rising GNP point to a fourth-quarter upturn.

National experienced a slight upturn in sales in May and June, says Keith Kolerus, the company's vice president of sales. "But we are now seeing a second wave of cutbacks, generated entirely by the computer industry. Their backlogs are down, their book-to-bill ratios are down, their inventories and finished systems are up. It's having a whole new wave of impact."

Yet some executives think the worst may be over. Larry Hootnick, marketing vice president at Intel Corp., reports seeing signs that "we are at the bottom, or close to it. We are starting to see some indications that bookings will pick up. For one thing, there is a lot more short-term business. Instead of putting in orders for 8 to 12 weeks in the future, customers are waiting until the last minute and asking for short-term delivery. Cancellations are down and the unit book-to-bill ratio is moving toward unity."

Even improved bookings won't help the situation much until next year, Hootnick adds. "There is a six-month lag time. The first quarter of 1986 may be decent, and by the second quarter we will be OK, but the next three to six months will be terrible."

STRONG DEFENSE. Peyton Cole, manager of strategic marketing at Fairchild Camera & Instrument Corp., says aerospace and defense business has kept Fairchild's book-to-bill ratio ahead of the industry average. The company expects the ratio to hit 1 : 1 by year end. But Cole adds, "We are by no means wildly optimistic. The second half will be very tough and we may have to take more austerity measures," such as layoffs and plant closings.

Computer maker Burroughs Corp. reported strong increases in June orders. But both Burroughs and Honeywell Inc. reported flat second-quarter sales compared with 1984 figures. Honeywell reported that though its orders increased in the second quarter, it would not have to buy any semiconductors to fill them. In fact, according to one supplier, Honeywell has enough semiconductors to last until next March.

NCR Corp. reported increased bookings, amounting to the highest dollar value in the company's history in the second quarter. Control Data Corp. reported that new orders had caused it to increase its 1986 growth forecasts from 20% to 30%. Hewlett-Packard Co. corporate economist Richard O'Brien says his company had at least seen an end to deterioration of orders, and he expects a fourth-quarter upturn.

But even an upturn in the computer business may not mean a lot to semiconductor makers, cautions Hal Feeney, technical computer specialist at Dataquest Inc., a San Jose, Calif., market research company. "Right now, there is substantially more semiconductor capacity than there is demand. Systems suppliers are in a position to write some very substantial deals." Very few suppliers are willing to make long-term contracts, though, preferring to buy only what is needed and wait for prices to erode even further than they already have, Feeney says.

In the face of this widespread caution—if not outright skepticism—about an upturn, and undeterred that his model failed to predict the current slump, Cuhney is sticking to his guns. He is sure that "gross inventories should come down again in the summer quarter." In August and September, "the semiconductor user is going to see the need to refill depleted stocks."

Will an upturn in IC orders come this year?

Gross inventories were down 0.4% in May, the largest one-month drop since December. Cuhney's evidence for the upturn is falling inventory figures and what he sees as a resurgent GNP.

Another indicator is the increase in distributor orders from 17% to 27% of the market, at the expense of orders from original-equipment manufacturers. "This is a tipoff that OEM stocks have bottomed out," Cuhney says.

But executives at two leading U. S. components distributors say they see no sign of an end to the slump this year. "We see absolutely nothing to indicate a turnaround," says chief executive officer Stephen P. Kaufman of Arrow Electronics Inc., Melville, N. Y. "And believe me, we've been looking."

Robert Johnson, president of Schweber Electronics Corp., Westbury, N. Y., says his company had a very bad May and June. But in July, "things may have gotten worse less rapidly." Underlying problems of overcapacity and deterioration in demand and in pricing have not gone away, he says.

SHRINKING PIE. Ray Woo, vice president of Western Microelectronics, a Silicon Valley distributor, agrees with his New York colleagues. "The reason the distribution percentage is up is that the pie is smaller," he says.

Michael Kubiak, statistician for the Semiconductor Industry Association, accepts Cuhney's claim that GNP fluctuations threw off his model this year. But Kubiak is cautious about a turnaround. "Real demand is down 50% from a year ago. We have rationalized ordering and inventory patterns, and the demand hasn't come back." *–Clifford Barney*

INTERNATIONAL TRADE

ITC SEES MERIT IN DUMPING CHARGE

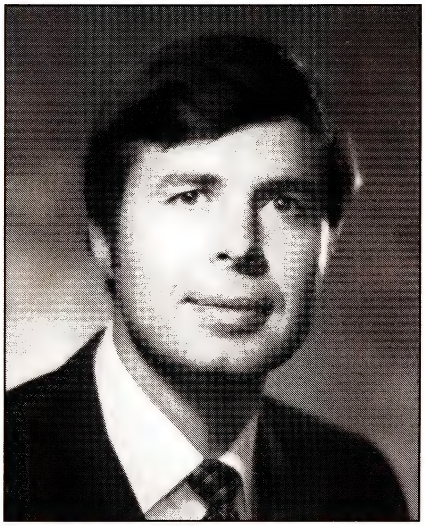
WASHINGTON

The U. S. semiconductor industry is finding Washington a faithful ally in its intensifying struggles over trade with Japanese chip makers. First came on July 11 the White House's swift, predeadline acceptance of the Semiconductor Industry Association's petition seeking trade relief from predatory pricing [*Electronics*, June 17, 1985, p. 13]. Then the International Trade Commission was expected to rule last week that imports of Japanese 64-K dynamic random-access memories are causing material injury to the U. S. industry.

That charge was filed last June by Micron Technology Inc. against seven Japanese producers. The Boise, Idaho, firm is calling for dumping duties in an attempt to reverse its fortunes, which began to fail a year ago.

"Currently, we're looking at 1985 sales of about $57 million, compared to $84 million in 1984," says Micron president Joe Parkinson. Since September, the per-unit price of Japanese 64-K DRAMs in the U. S. has dropped from $2.20 to below $1.00, with spot market prices in late May of less than 40¢, he claims. As a result, "we've had to renegotiate all our contracts to the point where we're no longer meeting costs."

Since February, Micron has shut down one of two wafer-fabrication lines and halved its employee roles—to 700 workers. The recession now plaguing the U. S. industry can be traced to both market barriers in Japan and dumping here in an effort to drive the few remaining U. S. memory producers out of the business, Parkinson maintains.


HURT. Micron Technology's Joe Parkinson says he isn't meeting costs.

Using a cost-construction model developed by Integrated Circuit Engineering Corp., Micron estimates that the fair foreign market value of a Japanese 64-K DRAM is around $1.36, but it currently sells for about 70¢ in the U. S. That indicates a dumping margin of 66¢ per unit, or 94%.

With a favorable ITC ruling, the case will go to the Department of Commerce for a preliminary determination of a dumping margin. It will then be sent back to ITC for final action some time in early 1986.

JAPAN MUST BUY. Dumping is one of the key motivations underlying the SIA petition, filed under Section 301 of the amended Trade Act of 1974. It's precisely to avoid cases like Micron's that the industry is calling on the President to press for a dramatic improvement in U. S. sales to Japan, asserts Richard W. Heimlich, vice president of Motorola Inc. Micron is not a member of SIA and insists that only retaliation at home can force an opening of Japanese markets.

But if the SIA's 301 petition fails to produce results, Heimlich expects a rash of Micron-type dumping suits from U. S. manufacturers. "Japan's excess produc-

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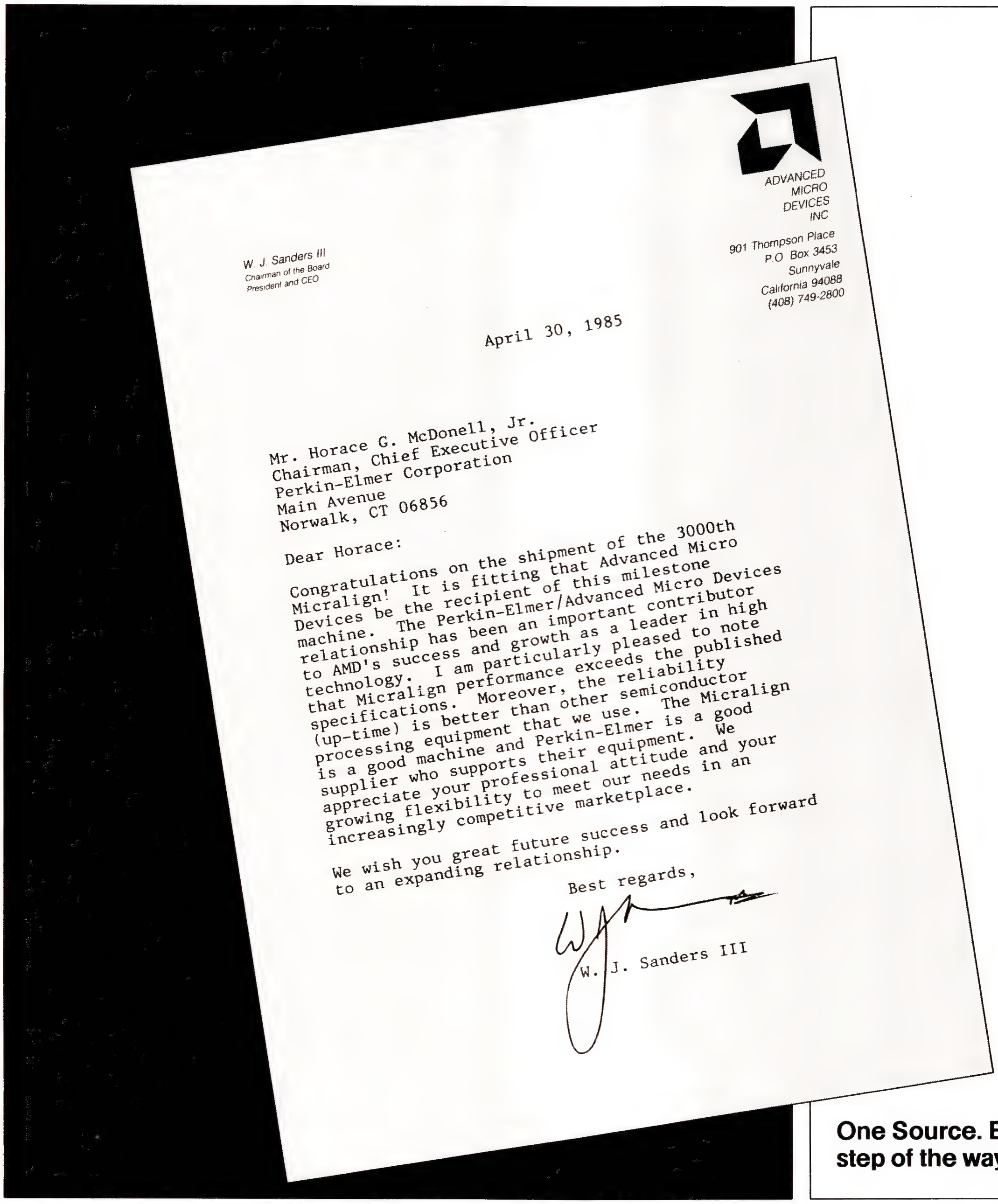

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W. J. Sanders III
Chairman of the Board
President and CEO

April 30, 1985

Mr. Horace G. McDonell, Jr.
Chairman, Chief Executive Officer
Perkin-Elmer Corporation
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Norwalk, CT 06856

Dear Horace:

Congratulations on the shipment of the 3000th Micralign! It is fitting that Advanced Micro Devices be the recipient of this milestone machine. The Perkin-Elmer/Advanced Micro Devices relationship has been an important contributor to AMD's success and growth as a leader in high technology. I am particularly pleased to note that Micralign performance exceeds the published specifications. Moreover, the reliability (up-time) is better than other semiconductor processing equipment that we use. The Micralign is a good machine and Perkin-Elmer is a good supplier who supports their equipment. We appreciate your professional attitude and your growing flexibility to meet our needs in an increasingly competitive marketplace.

We wish you great future success and look forward to an expanding relationship.

Best regards,

W. J. Sanders III

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PERKIN-ELMER

tion capacity in light of a refusal to hold down production in a contracting market has to spell dumping," he contends. Intel Corp. is just one among many companies rumored to be preparing such a case. The target: Hitachi Ltd. and its electrically erasable programmable read-only memories.

Before that happens, Heimlich says the SIA will put the heat on Congress to stimulate "meaningful" presidential action through the threat of protectionist legislation. Meanwhile, another executive agency could soon be entering the picture. A group of senators recently sent a letter to Attorney General Edwin Meese requesting a Justice Department examination of the evidence for hitting Japanese vendors for violations of antitrust laws. *–Karen Berney*

TELECOMMUNICATIONS

SIEMENS CHARGES AFTER U.S. TELECOM-CHIP MARKET

MUNICH

We didn't spend millions of dollars developing telecom chips just for our home markets," insists Rudolf D. Schwenger, a senior director in Siemens AG's Components Group. "The world is our battleground."

With that bugle call, West Germany's biggest integrated-circuit producer—IC sales came to about $300 million last year—is about to step out of the confines of Europe's fragmented markets and launch an assault on the U. S. and Canada with its ICs for telecommunications equipment.

The drive marks the first time that Siemens will introduce products other than commodity items such as memories, microprocessors, and consumer circuits in the North American market. Armed with a number of telecommunications chips and circuit specifications, the company is gunning for a piece of the large North American market for ICs that are compatible with line cards and integrated services digital networks (ISDN). Werner Flagge, product manager for telecommunications circuits at Siemens, pegs the market at $100 million this year and figures it may well go to $500 million by 1990.

EXCESS CAPACITY. Siemens bases its estimates on an expected push on export markets by U. S. switch producers. They acknowledge that U. S. installations of public switching systems are not likely to grow by more than 8% or so a year. But they think excess capacity will force more U. S. exports, and so switch makers will need more telecom chips. "The big market is clearly in the U. S., as regards both the dollar volume and the number of devices," says Schwenger.

Officials at the West German company believe several factors will make Siemens a force in telecom ICs. For one, the $17 billion company has the money it takes to finance the long lead times needed for research and development of communications circuits.

Siemens has already spent some $25 million during the past few years on its telecom-chip development effort. As many as 100 designers have brought out some 30 parts, including the derivatives of basic circuits. "All this is not something for the small, financially strapped guys," Schwenger notes.

BATTLE PLAN. Schwenger maps out Siemens' foray on the U.S. telecom-chip market.

Fast and easy access to systems know-how is another factor the company sees contributing to its strength. Siemens ranks third among the world's communications-equipment and switch producers, and the firm has six years worth of experience in Europe's telecom-circuit market. That region accounts for one third of the world's communications business; the U. S. accounts for another third. To gird for the battle in the North American arena, Siemens has been building up its sales, marketing, and applications-engineering force at its U. S. facility in Iselin, N. J. "We now have our act together to do business in America," Schwenger declares.

Deep pockets are needed in telecom R&D

"Given the expertise and reputation of U. S. companies such as Advanced Micro Devices and Intel, that business will be tough," he is willing to admit. "However, we are confident we can make it because our circuits use less chip area and are more flexible. They provide a good solution to the needs of both private-branch-exchange and central-switch manufacturers."

Siemens will make its U.S. push with a line of established products, as well as new designs, according to Flagge. The spectrum includes the PEB2040, a digital n-MOS part that functions as a switching network on a chip and handles up to 512 subscribers [*Electronics,* Nov. 30, 1982, p. 69].

Another n-MOS digital part is the PEB2050 peripheral board controller, which links the subscriber circuits to the pulse-code-modulated voice and data channels [*Electronics,* Jan. 13, 1983, p. 86]. There is also the PEB2060 signal-processing codec filter (Sicofi), introduced early this year [*ElectronicsWeek,* Aug. 20, 1984, p. 32].

New in the series are four digital CMOS parts: the PEB2070 ISDN-communication controller, the PEB2080 S-bus controller, the PEB2090 ISDN echo canceller, and the PEB2095 ISDN burst controller. All four parts are based on 2-μm technology.

SAMPLES THIS YEAR. The 2070 ISDN communications controller handles the protocols on the signaling channels in public switched networks or private branch exchanges. It has a first-in first-out structure and an on-chip link-access protocol controller for performing multiframe operations autonomously. Samples will be available in December of this year, the company says.

Also due in December are samples of the 2080 S-bus interface circuit. It is located in the subscriber terminals and the network terminations of public switched networks. The 2080 incorporates a receiver function, timing recovery for different operating modes, circuitry for collision resolution, and a state-control block to handle the activation and deactivation procedures without the support of a microprocessor.

Set for sampling in mid-1987 is the 2090 echo canceller, which derives the echo signal from the transmitted signal by way of adaptive transversal filters. This emulated echo signal is digitally subtracted from the receive signal to reconstruct the echo-free usable signal. The 2090 also performs equalization by digital signal processing.

The 2095 ISDN burst controller enables transmission over a twisted-pair copper cable up to 2.5 km in length. The device integrates an adaptive equalizer, as well as a phase-locked-loop circuit for clock and frame recovery. Its internal frequency is 384 kHz and transmissions are carried out in the AMI code. Siemens expects to ship samples of the 2095 in December 1986. *–John Gosch*

CONSUMER ELECTRONICS

WORD PROCESSORS GET PERSONAL IN JAPAN

TOKYO

The Japanese household has a new addition—a word processor. The entry price of Japanese-language word-processors has fallen so precipitously in recent months—to less than half what it was a year ago—that low-end models, which look more or less like electronic typewriters, could become standard equipment in the average home.

The Japanese call the new low-cost products personal word processors. Westerners might be tempted to dismiss them as souped-up typewriters: the machines have limited text memory and editing capabilities. But word processors they are. They automatically change phrases typed in Japanese syllabary or the Roman alphabet into natural Japanese text, which mixes Chinese Kanji and syllabary characters.

Kanji is needed because Japanese has many words that are written identically in the phonetic syllabary. The thousands of Kanji characters make it impractical to enter them from a small keyboard, so it is necessary to enter text in syllabary and perform the conversion step.

Techniques for entering this complex text into a system and printing it out have been developed in the past few years for office data-processing systems. Now, thanks to advances in integrated-circuit density and programming, consumer versions sport many of the capabilities of the full-featured office processors.

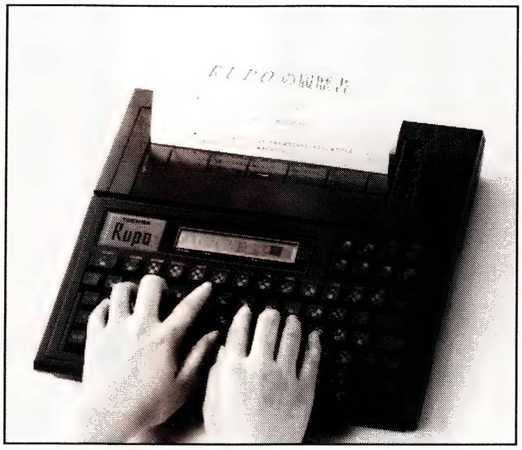
3,900 CHARACTERS. The Rupo word processor from Toshiba Corp., Tokyo, for example, stores in read-only memory a dictionary with more than 67,000 words for text conversion and a font of some 3,900 24-by-24-dot characters for printing. The Rupo sells for under $420.

The Rupo converts text from syllabary to Kanji phrase by phrase, which makes possible conversion that is correct more than 98% of the time. Most other word processors in the price range convert by individual Kanji character.

The character-by-character approach requires multiplying the number of conversions because most phrases have several Kanji characters. Moreover, most conversions produce a list of Kanji characters from which the correct one must be selected. Though inconvenient, this process is tolerable for small jobs. One machine sold by Brother Industries Ltd., Tokyo, converts word by word, putting it midway between the two methods.

But Toshiba by no means has a stranglehold on the market. So far this year, at least 17 portable Japanese word processors with list prices below $850 have come on the market. Competitors so far have failed to match the Toshiba product in either performance or price, but they will likely catch up soon.

According to an estimate by the Japan Business Machine Makers Association, manufacturers will produce about 450,000 word processors of all types during this calendar year, up from 210,000 last year. The figures, which are only for dedicated word-processing equipment, show the number of units rising far faster than dollar value because of the low-price products. This year's projected $539 million market compares with last year's $358 million. In addition, most Japanese computer work stations and high-end microcomputers have full-featured word-processing capability.


PHRASEMASTER. Toshiba's word processor converts phrases in Japanese syllabary to Kanji characters.

The Rupo's engine is a composite CMOS chip with a Z80 microprocessor, interrupt controller, peripheral input/output, clock, and glue logic, fabricated by a process that Toshiba calls superintegration [*ElectronicsWeek,* Jan. 1, 1985, p. 17]. Four 1-Mb mask ROM chips contain font and dictionary, with more than 2 Mb dedicated to the font.

Kiyoshi Yoshii, manager of the Word-Processor Design Engineering Section at Toshiba's Ome Works, says the Rupo's architecture is not clean and speed suffers, but it is adequate. A 256-K ROM contains the system program, including word processing and control of keyboard and thermal printer. The word processor uses a 64-K static random-access memory for work space; the RAM stores up to 1,600 characters of text—one page filled solid, or about 1½ pages of average text.

An analog or digital data recorder—a cassette recorder of the type used with home computers—can store any amount of additional text. The keyboard is a membrane type, to keep cost low, but standard keytops and a reasonable key travel improve its feel. Also helping to keep Rupo's cost down is the use of a single motor to handle print-head advance, ribbon advance, and carriage return. The user can switch the ribbon cartridge at any time to change colors.

Toshiba's Yoshii is proud of the printer's 24-by-24-dot character resolution because it prints much more clearly than do the 16-by-16-dot printers common in inexpensive word processors. It can print characters with halved width, doubled width, and doubled height and width, as well as outline, extra-large, and upside-down characters.

Other vendors are adding to their word processors' memory capability by means other than tape. Brother offers a 3½-in. battery-powered disk drive with a capacity of 180-K bytes, or 86,000 characters, for a $170 list price. Several firms have plug-in battery-backed RAM cartridges, and Sharp offers an expansion memory board. *–Charles L. Cohen*

MILITARY

AN OLD IDEA MAY SOLVE VHSIC COOLING PROBLEM

EL SEGUNDO, CALIF.

Shaping up as a major problem for military electronics makers is cooling the densely packed, blazingly fast chips due from the Pentagon's Very High Speed Integrated Circuit program. The chips will produce more than double the 100 W or so of heat dissipated by a digital circuit board in today's most advanced radar signal processor.

But researchers tackling this problem at Hughes Aircraft Co. and some other big military-electronics houses are making headway with a technology from the past: heat pipes. These cooling devices, thought for many years to have potential, never quite made it as a mainstream method of removing heat from electronic equipment: they were too difficult to make. The heat pipe is a simple hermetically sealed device, either round or flat, that contains a capillary-wick structure and a small amount of vaporizable fluid—freon, ammonia, or water. It transports thermal energy when the heat generated by components on a board causes the fluid to evaporate and move to the cooler end of the pipe. There the vapor condenses, removing heat, before it travels back to the other end in a continuous cycling action.

With no moving parts, the pipe is very reliable. Invented by General Motors Corp. in 1944, heat pipes found little use until the early 1960s, when they were proposed for cooling circuitry in early spacecraft.

Now, by embedding flat structured heat pipes in avionics boards and improving the manufacturing proces, Hughes has found an efficient way to move thermal energy generated by the components out to the sidewalls of the equipment chassis, where air or liquid can flow through it to dissipate the heat. The goal is not only to hold all component temperatures below the trouble point, but to keep temperature differences between parts as low as possible.

Current avionics boards rely on solid aluminum or copper substrate plates to conduct heat to the sides. However, temperatures of 64-K random-access-memory chips, for example, can vary by up to 16°C with this system. That variation could cause higher-stressed parts to fail sooner.

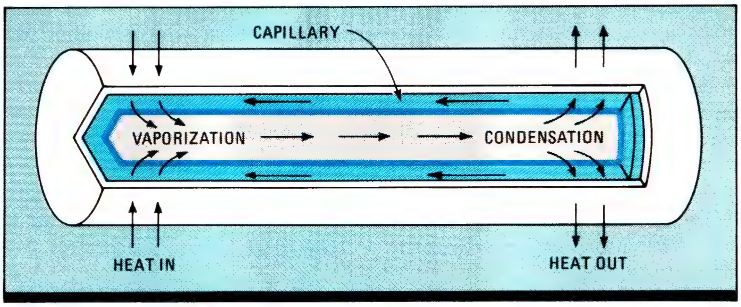
In tests using the new, modified pipes, temperatures for all components stayed within 3°C of one another. Moreover, gate arrays located near the center of the boards, the hardest spot to cool, operated about 16°C cooler than with an aluminum cooling plate.

A SIGNIFICANT CHANGE. Hughes researchers are convinced that these new heat pipes are the answer for future avionics cooling. "We're looking at a significant change, a whole new way of thinking," says Charles P. Minning, assistant manager of the Radar Systems Group's digital-processor department.

The payoff for better cooling systems is higher component reliability, and experimental testing shows that mean-time-between-failure rates of memory parts can be boosted up to 60% with heat pipes in place of metal plates.

In its two-year program, Hughes evaluated other techniques, too, including immersing avionics boards in liquid and flowing liquid through a heat exchanger. Although these heat exchangers are efficient, they are limited by difficulties in maintenance, particularly of liquid seals, and can become contaminated.

The only drawback of heat pipes is cost; Minning believes that "the essential technology is here, and we know how to put them together." But manufacturing them in volume would solve the cost problem, and Hughes is in an advantageous spot to carry it out through its Electron Dynamics Division, Torrance, Calif., the leading producer of conventional heat pipes for industrial and military tasks. The spur to high manufacturing volumes would be demand from avionics systems on the contemplated next-generation Air Force interceptor, which will need the improved cooling. Requests for proposals from contractors could come later this year.



BOILING POINT. The hermetically sealed heat pipe, a flattened version of which is used by Hughes, cools by vapor condensation and features a cycling action.

In late May, Hughes gave a presentation on the advantages of heat pipes at the National Aerospace and Electronics Conference in Dayton, Ohio. The company reports widespread interest.

David S. Steinberg of Litton Industries Inc. says the only word for heat pipes is "remarkable." He thinks they will be particularly useful in cooling the more dense boards of the future. As manager of mechanical design and analysis for Litton's Guidance and Control Systems Division, Woodland Hills, Calif., Steinberg has vast experience with the pipes. That experience includes work on their most extensive application yet—in the guidance unit for the Air Force's cruise missile. Each missile uses 12 pipes, which were supplied on a custom basis by Hughes. Steinberg claims the pipes conduct heat very efficiently, and cites the heat loss along the pipe as only 0.1°C/in.

Hughes is not alone in its program: other aerospace firms have published material on internal heat pipes. Among those known to be working on heat pipes are Grumman Aircraft, McDonnell Douglas, and Westinghouse Electric.

"Everybody is working on them because they are the only thing that looks to do the job," according to Minning. Litton's Steinberg agrees with him: "I firmly believe heat pipes are the only way to go." *–Larry Waller*

NAVIGATION

LOW-COST FIBER GYRO ACHIEVES HIGH ACCURACY

CORBEVILLE, FRANCE

A digital processing technique commonly used in radar equipment may move fiber-optic gyroscopes toward uses that require maximum precision. Engineers at Thomson-CSF are applying the technique, which is called digital phase-ramp processing, to the development of a fiber-optic gyroscope.

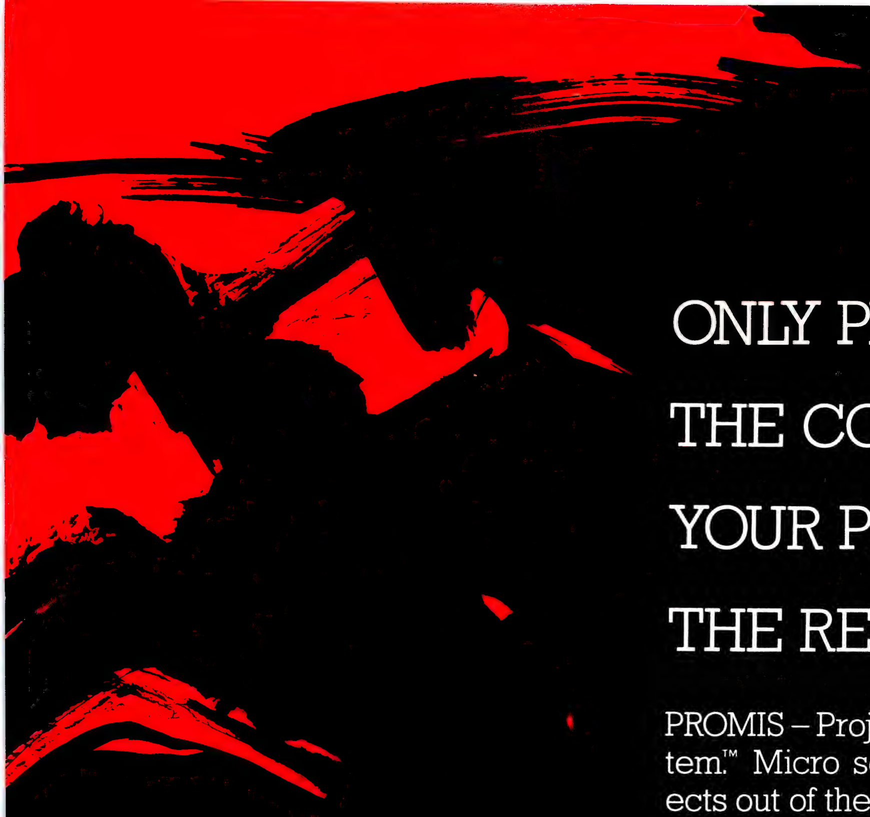
Technique used in radar boosts unit's stability

The company's Central Research Laboratory near Paris, working with the company's General Aviation department, offers no word about when it plans to produce a commercial product. But Hervé Lefevre, manager of the Optical Fiber Sensor department at the lab, expects such devices to be many times cheaper to produce than laser gyros with their vacuum cavities and highly polished mirrors. When the fiber-optic gyros are produced in volume, he expects prices may drop to below $1,000 each.

The Thomson gyroscope has a volume of only 1/10 liter, which is less than half the size of most fiber-optic gyroscope brassboards and much tinier than laser gyros. In addition, it boasts a drift rate of less than 0.3°/h, with a dynamic range of 1,000°/s. This is accurate enough for the vast majority of high-precision aerospace and military applications.

Like all fiber-optic gyroscopes, Thomson's is based on the fact that rotational motion affects the phase of a light beam and uses a fiber-optic coil as the medium, or cavity, in which the light propagates. To weave the necessary components into a system, Thomson uses an integrated optics approach, coupling the fiber coil to the laser light source and photodetector by way of a planar optical integrated circuit that incorporates monomode waveguides.

The optical IC splits the beam of light



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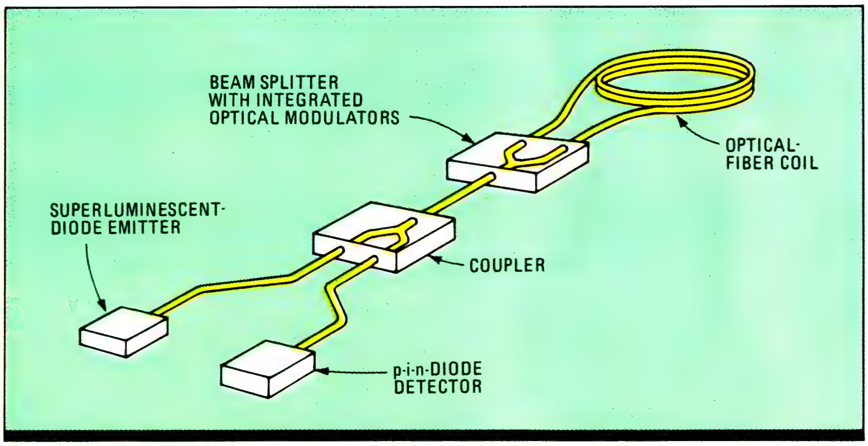

BEAM SPLITTER WITH INTEGRATED OPTICAL MODULATORS
OPTICAL-FIBER COIL
SUPERLUMINESCENT-DIODE EMITTER
COUPLER
p-i-n-DIODE DETECTOR

AROUND THE LOOP. Thomson's gyro uses digital phase-ramp signal processing, allowing the detector and its associated electronics to work in a closed-loop arrangement.

from an optical source and recombines the two resulting beams after they have propagated around the fiber coil. Thomson had been using an IC with a second beam coupler for connections to the light source and detector, but found it got better results with a separate coupler for that task.

To detect rotation, a standard fiber-optic gyro uses the phase difference in the waves of light in the two beams after they have traveled around the loop. The approach's drawback is that the signal has a sinusoidal response that is affected by external factors such as changes in temperature and the amount of optical power that falls upon the detector. Such analog systems are thus less stable and linear.

Thomson's exploitation of digital phase-ramp signal processing addresses this problem. Wideband modulators sitting on the surface of the optical IC generate a sawtooth signal with an interval equal to the time of propagation in the fiber coil.

The detector and its associated electronics work in a closed-loop arrangement. When the p-i-n diode detects a variation between the propagation time and the interval of the signal, the circuit adjusts the modulator until the two periods are equal.

CLOSED LOOP. By constantly adjusting the modulation in this way, the detector can derive the amount of rotation that the gyroscope is undergoing as a function of the variation of the signal interval versus the propagation time. Because the system is a closed loop, it eliminates problems of stability (such as those caused by temperature changes) and resulting accuracy-reducing linearity difficulties. *–Robert T. Gallagher*

LOCAL-AREA NETWORKS

WORLD BANK SETS UP WORLD-CLASS NET

WASHINGTON

The World Bank, which deals routinely with loans in the billions of dollars to developing nations, also thinks big in communications. The international agency spent three years modeling its communications needs and came up with a plan for one of the largest local-area networks ever created, based on Proteon Inc.'s token-ring technology.

In early July, the first of some 6,000 personal computers were delivered to desktops in 14 World Bank buildings ringing the campus of George Washington University. These computers ultimately will be threaded together with shielded twisted-pair wire going to eight IBM Corp. and Burroughs Corp. mainframes and nine minicomputers in a net covering 2½ million ft^2 of office space.

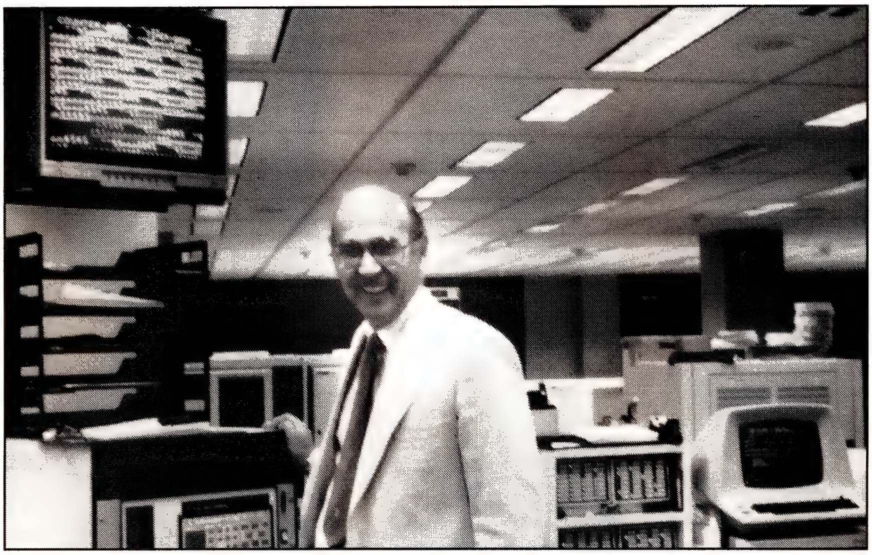
"If anything came out of our study it is that the sharing of information is crucial, and distributed systems are the best way to introduce technology to the whole bank," says Howard G. Conrad, chief of the network communications center at the World Bank.

Such wisdom came only after ad hoc additions to the bank's data-processing systems eventually pushed it to systematically examine its needs.

The international lender of last resort for financially shaky governments, the World Bank is a collector, producer, and consumer of huge amounts of data used to establish the credit-worthiness of debtor nations. During the 1970s, various organizations within the bank rushed to computerize their operations, leaving the data-processing group to cope with incompatible hardware and data bases serving 6,000 professional staff members and another 2,000 consultants. It also ran up a data-processing bill of close to $44 million last year.

The search for a networking solution began with the choice of a wiring plan. "We concluded that an integrated data-management plan would evolve over its 15-year lifetime, but wiring does not change," Conrad explains. "We figured we had one shot and had to guess at the state of the art 10 years down the line."

With an eye on developments in token-ring technology, Conrad says he closely examined both the AT&T Co. and the IBM wiring schemes. Though AT&T selected the World Bank as a beta-test site for its Information Systems Network—a campus-wide distribution system using twisted-pair telephone wiring and added fiber-optic cable—the finan-



CASTING A WIDE NET. After a three-year study, Howard Conrad decided that distributed systems were right for the World Bank and launched one of the largest local-area networks yet.

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cial agency finally decided against ISN.

“AT&T says its ISN will handle anything up to 3 Mb/s, but we weren’t sure this would take care of our needs in five years,” Conrad says. Even more telling, in his view, was the use of in-place copper pairs for data delivery. “If you use that sloppy, old, undocumented wiring to run your network, you’ll get what you deserve. In-place wiring for data transmission is a myth that needs to be debunked,” Conrad maintains.

TEST RUN. Besides the AT&T cabling scheme, a prototype IBM cabling system was also installed. It won high marks for its engineering and documentation, but proved too costly. The group also tested versions of Ethernet, the thin-cable RG58AU version of Ethernet called Cheapernet, and the broadband Localnet from Sytek Inc., Mountain View, Calif. “We modeled our network needs and did a cost analysis, and shielded twisted-pair wire won out,” Conrad says.

Once he had completed the cabling analysis, Conrad shifted his attention to network protocols. “CSMA/CD [collision sensing, multiple access with collision detection] proved inappropriate because we couldn’t establish the delays involved in adding stations to the network,” Conrad says. So, confident about IBM’s stake in token-ring technology [*Electronics*, July 15, 1985, p. 16], the bank decided on a version of the token-ring technology produced by Proteon Inc., Natick, Mass.

The bank chose a net based on token-ring technology

IMPRESSIVE TECHNOLOGY. “The World Bank was favorably impressed by the fact that we ran successfully on the IBM cabling system being installed at Carnegie-Mellon University,” says Paul L. Rosenbaum, Proteon’s president. A token ring works by passing a string of bits—the token—along a cable shaped as a ring. Each computer along the ring passes its data only when it receives the token—so the network can calculate the delay before transmission and avoid contention.

Several factors worked in Proteon’s favor, explains Conrad. “They supported our cabling decision with their 10-Mb/s version on shielded pairs, they support a fiber-optic transmission, and we knew they had an 80-Mb/s version coming, so we could see a migration path.”

Another Massachusetts outfit, Banyan Systems, of Westboro, was tapped to provide networks servers, the intelligent devices linking LANs to each other and to mainframes at the bank.

“The bank defined its specification for network servers according to what they though was generally available, but they also had a wish list of what they wanted three years out. We met the long-term goals right off the bat,” says Gary McGrath, Banyan Systems’ major-account representative.

By using Unix System V and the Small Computer System Interface to peripheral devices, Banyan delivered a potent file- and print-server combination. A proprietary networking architecture makes it possible to mix Ethernet, Omninet, and Proteon’s Pronet cards in the backplane. Its back-end services include synchronous and asynchronous communications to hosts as well as X.25 service to public networks. *–Robert Rosenberg*

INDUSTRIAL ELECTRONICS

WELDING MASK ADJUSTS FOR ALL LEVELS OF LIGHT

BUDAPEST, HUNGARY

A Hungarian invention puts liquid-crystal and solar-cell technology to novel use in a protective mask for welders. The Wodelic electronic mask quickly darkens when it senses the blinding light from a welding arc. Thus a welder can see in normal light without removing his helmet. Because he does not have to constantly raise and lower the mask, he can work both better and faster.

BRIGHT IDEA. A liquid-crystal panel in the Wodelic mask darkens when it senses blinding light from a welding arc.

The light produced by a welding arc is extremely bright and damaging to the eye, so welders must wear goggles or masks that admit only a fraction of the light. In the Wodelic mask, made by welding-equipment producer Terminal Co., located just south of Budapest in Szigetszentmiklos, the welder looks through a liquid-crystal panel that responds rapidly—within 3 ms—to high light levels by switching into its less light-transmissive mode. When the arc light is removed, the panel becomes clear again in 1.5 to 2 s, and the welder can see in normal light.

Below the liquid-crystal panel is a photosensor and an array of solar cells that power the panel and its electronics, making batteries unnecessary. The welder adjusts the amount of light admitted with a potentiometer.

Allowing the welder to leave the mask on continuously offers more than convenience. Just before he initiates the arc, he can see clearly where he is positioning the welding rod. This is impossible with conventional protection. Therefore, the Wodelic mask contributes to the quality of the welded seam.

Some protection is provided—by a mirrored layer in front of the liquid-crystal panel—even if the user inadvertently puts his hand in front of the photosensor. This mirror reflects light in the ultraviolet and infrared ranges.

Ferunion Trading Company for Technical Goods, Budapest, exports the mask for about $120. The invention is credited to a team at the Budapest Technical University headed by Sandor Krekacs, a mechanical engineer who works for the Paraplan Engineering and General Contracting Bureau, Budapest.

The Welding Labor Safety Committee of Hungary’s Engineering Scientific Society, which cooperates closely with the Health and Safety Section of the International Institute of Welding, is encouraging the introduction of the Wodelic mask. The mask was tested and approved by the National Research Institute for Labor Safety, Budapest.

In addition to welding, the mask’s makers see uses for it in metallurgy, metal spraying, plasma technology, and other areas where high-level illumination is a problem. *–Karoly Ravasz*

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AT&T's GLOBAL PLAN TO SCORE IN COMPUTER MARKET

by Robert J. Kozma

TO COUNTER THE GAPS AND SHORTCOMINGS IN ITS PRDOUCT LINES, IT IS WEAVING A WORLDWIDE NET OF STRATEGIC ALLIANCES

NEW YORK

After divesting its telephone operating companies 19 months ago, AT&T Co. wasted no time in entering the computer business. It announced its first computer products in March 1984. Since then, the electronics world has been watching the telecommunications monolith try to forge a presence in the computer industry.

Clearly, AT&T wants to be in the forefront of the convergence of data processing and communications. It plans to use its skill in networking to provide total solutions for customers' information-processing needs. These solutions will be aimed at the departmental level of companies in the U. S. and around the world.

Though it will be moving into IBM territory, AT&T will coexist with its giant U. S. rival by continuing to offer gateways to IBM mainframes from AT&T minicomputers, terminals, and work stations. Nevertheless, AT&T's ambitions in the computer market only add to the problems that IBM faces as the computer giant struggles to maintain its preeminence (see story, p. 29).

But so far, AT&T has not proven much of a threat to any players in the computer game. To shore up its position and to fill the gaps in product lines, it is forming strategic alliances with anyone and everyone who is interested in Unix, the Bell Laboratories operating system that AT&T is championing as the software standard for many uses.

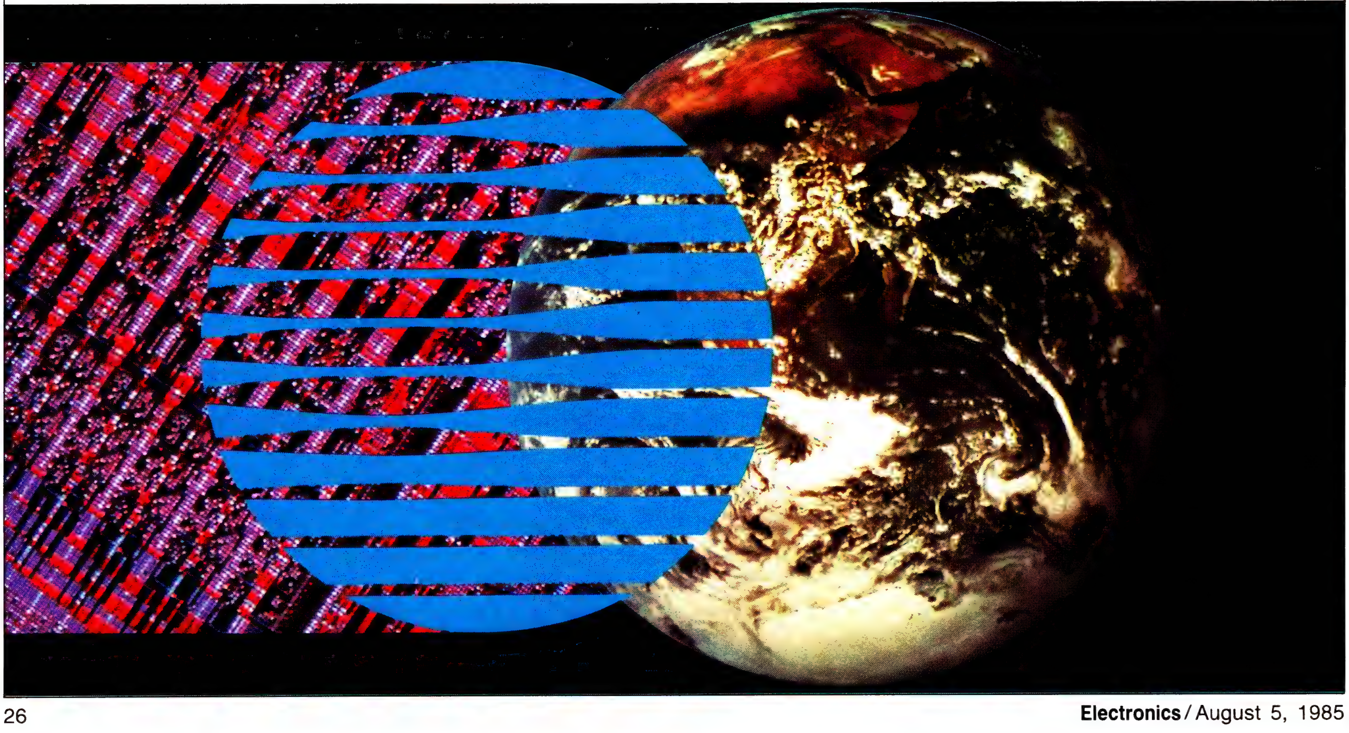
STILL A GAP. "There is still a gap between what AT&T is doing in the computer business and what other computer vendors are up to," notes Gwen Peterson, director of the Business Computer Services Sector at Dataquest Inc., San Jose, Calif.

"They still have more to learn [about the business] but they are taking steps to catch up," she says. By the end of this year, AT&T "will at least be above the status of 'also-rans' in most of the markets where they compete." But it won't be until 1986 or 1987 that AT&T becomes one of the top five vendors in its market segments, she adds.

"The computer business is the new business for us," says John E. Boyd, sales vice president for the Computer Systems Division of AT&T Information Systems. "It is critical for AT&T to move to computer technology to employ this technology, which we used internally, and to offer it to our customers. It's an important part of the future and the growth business of AT&T."

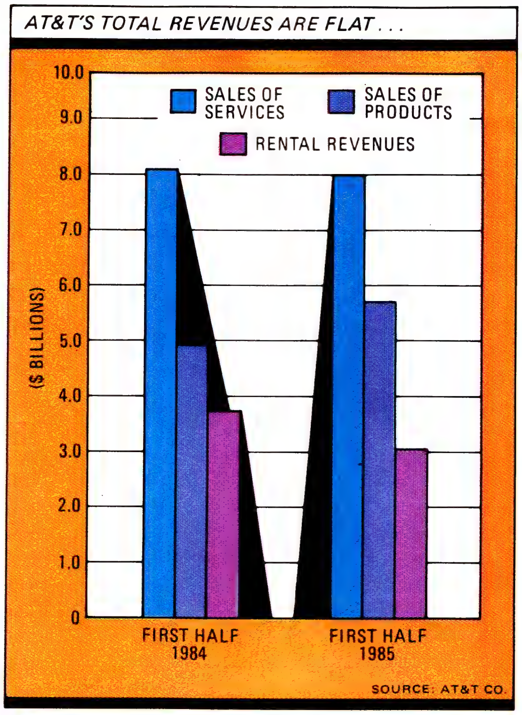
Growth is the name of the game. AT&T faces increased competition in the voice- and data-communications side of its business from a host of competitors, including a rejuvenated MCI Communications Corp. and its new partner, IBM. Revenue growth from this side of the business is going to slow, analysts point out, and profit margins will be harder to maintain (see charts, opposite). Indeed, AT&T's revenue from the sale of services in the first six months of 1985 fell 0.4%, to $8.1 billion, from the prior year.

It is to the equipment side—especially computers—that AT&T looks for an increased push in revenue and profits. Its



revenue from the sale of equipment rose 17% in the first six months of this year, to $5.7 billion. This reflected sales primarily of telecommunications gear, however, with relatively little impact from computer sales. AT&T wants that to change.

AT&T'S TOTAL REVENUES ARE FLAT . . .



SOURCE: AT&T CO.

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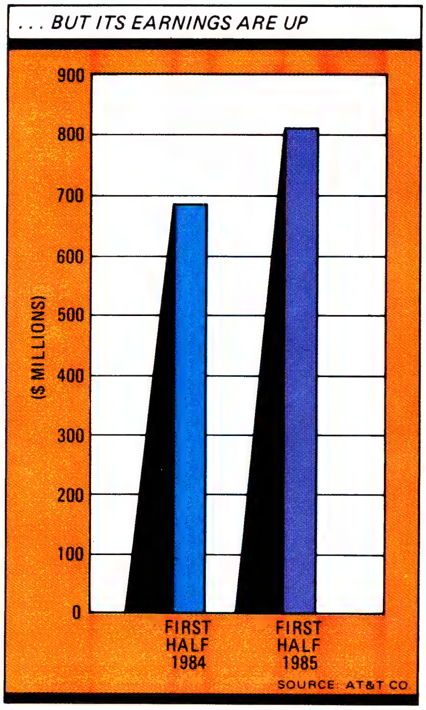


SOURCE: AT&T CO.

"AT&T's communications business far outstrips the computer business in revenue and earnings," Boyd notes, although he adds that the computer business is contributing to the bottom line. However, "it is important to the company that the computer business acquire an ever-increasing share of AT&T's business. We have aggressive plans to increase that over time." Those plans call for an annual growth rate of 20% to 30%, he says.

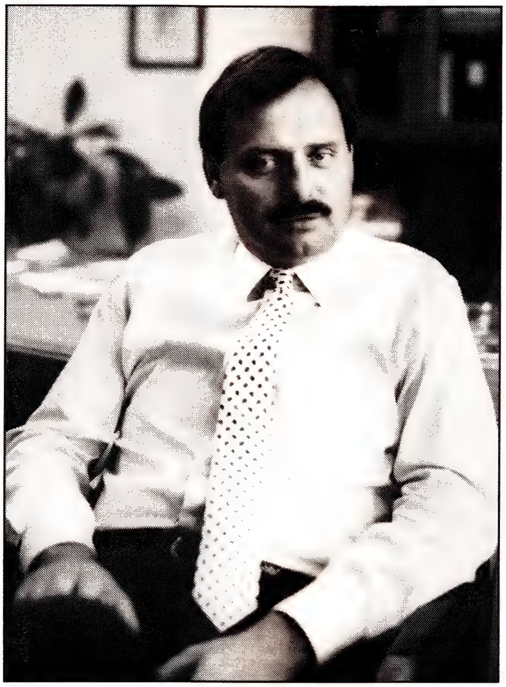
That growth will come not from pushing raw iron out the door, as other computer vendors do, but in integrating it with communications technology, observers say. "Their strategy is not to be just another computer company but to use computers to complement the other communications services they offer," says Mike Kennedy, an analyst who follows AT&T for the Gartner Group, Stamford, Conn.

"They look at the computer business as an element of their total system strategy. They want to emphasize communications and the total system rather than minicomputers and personal computers," he says.

DEPARTMENTAL PROCESSING. "We are not just another hardware vendor," AT&T's Boyd emphasizes. "Other competitors don't have the communications networking experience we have." Noting that the company is not in the mainframe-computer business (and probably won't be), he says, "We are, in fact, in the departmental-processor business. We view the department as the key to our strategy. We serve that level with computers, communications, and networking."

Boyd says the revolution in personal computers brought computing power to the people. But he adds that the processing revolution didn't provide a way for people to use that computing power easily and in a network. "We have the capability to take this power on the desktop and tie it together" through the company's Starlan local-area network and ISN (Information Systems Network) and through network servers so that work stations can communicate with each other, he says. Following this station-to-station communication comes department-to-department communication, and then work-station-to-mainframe communication.

In moving to tie together these now-disparate parts of the corporation, AT&T wants to capitalize on its expertise in voice communications. At last month's National Computer Conference in Chicago, AT&T's Personal Terminal 510, a voice and data terminal, generated considerable interest. "We want to move to the integration of voice and data to provide the full promise of office automation," Boyd says.



EXPECTANT. AT&T sees computers as "the growth business," says sales vice president John E. Boyd.

This strategy may allow AT&T to counter IBM and others in the market, thinks Michael Killen, president of Strategic Inc., a San Jose think tank. Killen recently lectured AT&T executives on strategic planning. New competitors in a market must always look for a gap in available technologies on which to focus.

"AT&T is searching for every seam—especially a work station with voice and data capabilities. They're looking for that tiny seam that might not be a big business now, but which will grow in the future. They are trying to capture the integrated voice-and-data work-station market," says Killen.

ONE CONTRACT. AT&T, though, has had success even without a seam market. On the strength of winning one contract, AT&T has joined the ranks of the major computer vendors in the U. S. The import of that contract—with the National Security Agency—goes far beyond the $946 million price tag for supplying a network of 325 Unix-based 32-bit minicomputers.

Certainly, the revenue from the contract "helps from the financial standpoint," says Boyd. More important, though, is that it "helps reaffirm the credibility of AT&T as a major player in the computer industry. When you get a customer as demanding as the NSA and displace the No. 2 player [in that market, IBM] and beat out the No. 1 guy [Digital Equipment Corp.], it is an achievement that grabs the attention of most potential customers."

Winning the NSA contract "also adds to the critical mass of Unix-based systems and increases the development of available applications software," Boyd says. "The more Unix hardware and

STRATEGIC ALLIANCES BROADEN AT&T'S PRESENCE IN COMPUTERS

Company	Arrangement
Olivetti Corp.	Makes the AT&T 6300, compatible with IBM Corp. Personal Computers
Convergent Technologies Inc.	Makes the AT&T 7300, a personal computer that operates with AT&T's Unix software
Electronic Data Systems Corp.	Joint marketing arrangement for custom-designed computer-networking solutions
Quotron Systems Inc.	Joint development and marketing of a computer-based financial-information system for stockbrokers and security analysts
Microsoft Corp.	Joint development of compatible versions of Unix System V and Microsoft's Xenix, which is derived from Unix
Motorola Inc., Intel Corp., Zilog Inc., National Semiconductor Corp.	Development of Unix System V for use with microprocessors made by these vendors
Amdahl Corp.	Agreement to ensure compatibility of Unix System V with Amdahl's UTS software
Omnicad	AT&T acquired an equity position in this company, which sells software for computer-aided design and computer-aided manufacturing; joint marketing of CAD software on AT&T personal computers
Value-added resellers, independent software vendors, original-equipment manufacturers	AT&T has signed up over 80 of these firms to help it penetrate niche markets

SOURCE: AT&T CO.

software there is in the market, the healthier it is for our strategy."

Yet industry observers point out that the same strengths that made the AT&T computers attractive to the NSA make them unattractive to the commercial market. "Their equipment tends to be very high quality, costly, and slow to change," says Kennedy of the Gartner Group. "That could be why they won the NSA contract: there is more synergy between the military market and the telephone business. But in the fast-moving commercial business, AT&T has trouble there."

SKEPTICAL OBSERVERS. AT&T's main engine, the 3B line of minicomputers is second-rate, observers say. Though they label it competent, they say that it isn't better than the competition's. "Our assessment of AT&T's computer technology is it's still behind that of Digital Equipment Corp., which is AT&T's principal competitor in the minicomputer business," says Kennedy.

To counter its shortcomings in both hardware and software, AT&T has entered into alliances with other companies (see table, above). Among the first was its deal with Ing. C. Olivetti & C. SpA for a personal computer—AT&T's 6300—that is compatible with those made by IBM Corp. Next, from Convergent Technologies Inc., came a faster, more powerful microcomputer dubbed the 7300, that runs Unix.

AT&T has also turned to alliances with software companies and niche product suppliers to help broaden its base. "AT&T has incredible strengths, but it's a big world out there," says Killen of Strategic. "Everywhere they perceive they have a weakness, they will form an alliance to compete with IBM" and other competitors.

One of AT&T's more interesting alliances is with Electronic Data Systems Corp., the Dallas unit of General Motors Corp., under which EDS staff members and AT&T sales representatives jointly market equipment and services. While AT&T supplies minicomputers, personal computers, terminals, and work stations, EDS helps provide mainframe expertise. "Working with EDS fulfills our systems integration role: to configure and provide complete, total systems on large to very large [sales] opportunities," says AT&T's Boyd.

Large sales force is playing catch-up to sell computers

Another alliance—with Quotron Systems Inc., Los Angeles—will let AT&T penetrate the growing financial-services market. AT&T has also signed up more than 80 value-added resellers and independent software vendors, Boyd says, who will help AT&T address other niches and broaden the availability of Unix software.

Although these strategic partners play an important part in AT&T's strategy to blanket the world, it is AT&T's large dedicated sales force that plays the key role in the company's operations. "Our flagship is the direct sales force," says Boyd. The Large Business Systems Division focuses on Fortune 2,000 customers, while the General Business Systems Division handles smaller customers. The two divisions have about 6,000 salespeople, Boyd says.

"This sales force is highly proficient on the voice side," Boyd notes, and the Computer Systems Division, under the direction of president James D. Edwards, has been working with them for the past year "to increase their skills." Learning how to market and sell computers "is quite different from selling telecommunications products," notes Dataquest's Peterson. "They still have more to learn but they are ramping up and taking steps to catch up" in this critical area.

PICKING UP SPEED. Commenting on the sales force's performance up to now, Boyd notes that it had, "in hindsight, an expectedly slow start in 1984. It's picked up speed in 1985. We are very, very encouraged by the progress of the sales force."

The sales force could find itself working even harder in the future. "The AT&T sales force is being positioned to [account for] 40% of AT&T's computer sales," Strategic's Killen says. "There is tremendous pressure being applied to them to meet that goal. Whenever a salesperson shows a telephone system or a private branch exchange, he must also push the computer line."

Yet the sales force must push computers, not as computers, but as part of an integrated package of processing power, software, and networking. "AT&T doesn't want to sell computers, it wants to sell applications," notes Gartner Group's Kennedy.

Still, just about every other computer vendor in the market today claims that it, too, sells solutions, not just hardware. "Everybody thinks they have the total solution. That's the idiocy of the high-tech industry," says Ken Zita, a senior analyst with Northern Business Intelligence Inc., a New York market research firm.

This approach to marketing—offering the total solution—brings AT&T right up against IBM. AT&T's Boyd believes that talk concerning the battle of the behemoths (AT&T versus IBM) is overblown, yet the two companies are natural competitors. "There is quite a lot of mimicry of IBM at AT&T," says Kennedy of the Gartner Group, citing the hiring of many IBM marketing executives. In targeting equipment to the office market, AT&T bowed to the obvious and introduced an IBM-compatible personal computer as one of its first products.

IBM, for its part, is aware of the challenge that AT&T wants to provide and appears to be doing its best to thwart its rival. Therefore, IBM is developing integrated voice and data work stations through its Rolm Corp. subsidiary. While AT&T is trying to establish Unix as the dominant software offering in the market, IBM has also latched on to Unix in an attempt to co-opt it.

"AT&T sees Unix as the way to get systems to work together. In this way, all vendors can build to the same standards and develop the market. Since AT&T controls Unix, they feel they can build on it. We're not so sure. IBM could use Unix, and maybe more successfully," says the Gartner Group's Kennedy.

IBM's sale of Satellite Business Systems to MCI Communications Corp. and its investment in MCI also show how the company is working against AT&T, observers believe. "That was an offensive strategy to strengthen the only viable competitor to AT&T's communications business," according to Killen. "By investing in MCI and making it more viable, IBM's goal is to cut into AT&T's resources from selling services, so AT&T can't use those resources to help fund its attempts in the computer business."

Though AT&T is now prevented from any sort of cross-subsidization of its business operations, Killen points out that "all restrictions are going away rapidly. No one can predict what level of regulations and restrictions will prohibit AT&T from what it can do."

Despite its problems, AT&T is likely to succeed in the computer marketplace, Killen believes. "They must become a significant force in computers. They know it. They know what will happen if they don't succeed. When you have that motivation and their level of resources, chances are they will succeed."

AT&T's corporate commitment to the computer business is "unquestioned," says Dataquest's Peterson, and the company is "bringing in the people who know the business." Still, AT&T faces a substantial challenge in a highly competitive market, where "the other vendors won't step aside." ☐

GROWTH GETS HARDER FOR IBM

CHICAGO

AT&T Co.'s drive to score in the worldwide computer market is just one of the growing problems that IBM Corp. faces as it struggles to meet its long-range growth goals in revenues and profitability. The world's leading computer maker is also encountering stiffening competition from fast-growing Japanese computer companies as they prepare to move more aggressively into the U. S. market. At the same time, there is a real possibility that the growth rate in IBM's major markets might be slowing down.

Because of such increasing pressures on IBM, some industry observers are beginning to turn bearish on the company's prospects for meeting its goals for profit growth (see top table). Such attitudes surfaced at a late July seminar in Chicago on IBM's prospects. The meeting was held by the Gartner Group Inc., a Stamford, Conn., market researcher.

The company has made no secret of its wish to grow at least as fast as the rest of the computer industry. More important, it wants to keep its profits growing at the same rate as revenue. Over the next few years, that would mean growth rates of at least 15% or 16%, say industry observers.

Meanwhile, IBM has already fallen victim to the slump now hitting the industry. Compared to an average 15.1% revenue growth over the past four years, IBM sales growth slipped to a 2% rate (revenue for the first six months was $21.2 billion, up from $20.8 billion in last year's first half), while profits declined by 15% to $2.4 billion.

Japanese vendors are also gearing up for a serious assault on traditional IBM turf, the huge U. S. data-processing market. One of the first major encampments is in Hillsboro, Ore., where Fujitsu Ltd., Kawasaki, Japan, plans by year end to bring on stream the first of seven U. S. manufacturing plants that will challenge IBM in the high-end disk-drive business.

Also, Hitachi Ltd. of Tokyo plans to start shipping to the U.S. next year its new high-end mainframe that features a processor with about twice the power of a single processor in the IBM dual-processor 3090 series. The Japanese are also planning to mount an attack on the U. S. office work-station market.

IBM also faces plenty of competition from the likes of AT&T and Digital Equipment Corp. in the market for intermediate systems that are expected to play the departmental management role, as the link between Personal Computer or work-station networks and central-site mainframes. It now serves this market with five different product families (the System 36, System 38, 4300, Series 1, and 8100). Users complain that none of these machines satisfies the need for a departmental system that has good upward and downward communications capability, strong data-base capabilities, good price-performance, and ease of use by inexperienced operators.

DRASTIC CUTS. As a result, IBM is likely to cut hardware prices drastically in many segments over the next five years, says Steve Cohen, a vice president at Gartner Group. New IBM price aggression in the face of Japanese competition will be particularly noticeable in high-end storage systems, he says. The firm has been able to hold 3380-class disk-drive prices well above historical learning curves, thanks to ineffective competition from the likes of such companies as Control Data, Storage Tech-

IBM'S EARNINGS GROWTH WILL TRAIL REVENUE GROWTH

	1975	1980	1985	1990	1995	20 year change
Revenue ($ billions)	14.4	26.2	50	102	219	+14.6 %
Gross profit (% revenue)	63.0	61.3	57.2	56.3	54.2	−8.8 pts.
Operating expense (% revenue)	39.2	39.4	35.7	33.9	32.9	−6.3 pts.
Net after taxes ($ billions)	1.99	3.56	12.85	8.09	26.06	+13.7 %

SOURCE: GARTNER GROUP

IBM'S SOFTWARE REVENUES WILL GROW

	1985		1990		1995	
	($ billions)	(%)	($ billions)	(%)	($ billions)	(%)
Processors and peripherals	25.1	50	44	43	78	36
Office systems/work stations	10.5	21	20	20	44	20
Software	4.2	8	18	18	61	28
Maintenance	6.1	12	12	12	25	11
Other	4.3	8	8	8	11	5
Total	50.2	100	102	100	219	100

SOURCE: GARTNER GROUP

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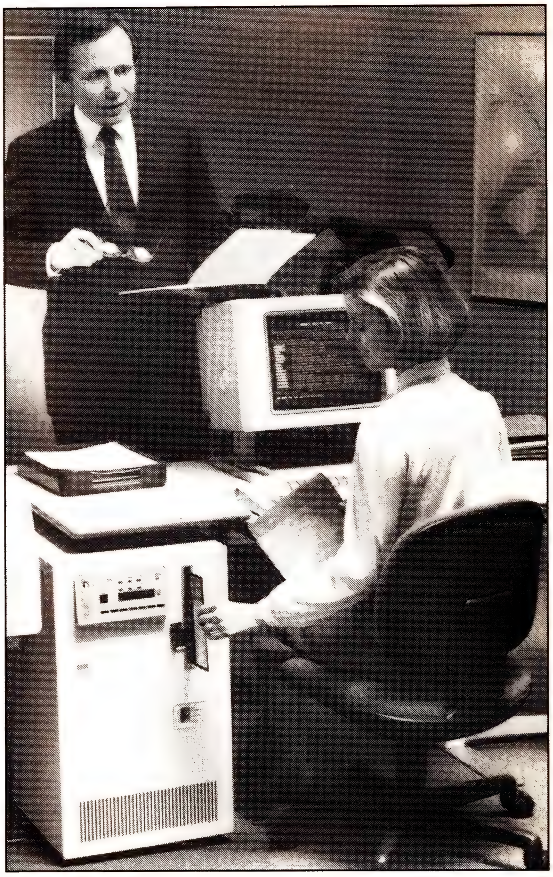
TARGET. IBM faces competition in the market for intermediate systems, such as the System 36.



nology, and Memorex.

However, "Fujitsu is certainly coming into this business with a vengeance, as is Hitachi," Cohen says. He predicts that to meet this thrust, IBM will have to speed up the rate of price-performance gains it offers in high-end disk drives to about 19% per year over the next five years, compared with the 9% average annual improvement in that sector since 1980. Price-performance improvement on IBM processors will also accelerate to about an 18% annual average rate, versus 16% over the past five years.

But for IBM users, the price breaks won't come free. IBM will aggressively move to offset shrinking margins in its bread-and-butter hardware business. It will continue to cut customer-support levels to save on expensive manpower. That means more customer setup of equipment, for example, and that IBM will use systems integrators, dealers, and value-added resellers who will be responsible for service and support. Meanwhile, prices on IBM software and maintenance will be rapidly increased or held at current highly profitable levels.

While maintenance is likely to remain profitable over the next 10 years, software is what will "keep IBM growing," Cohen says. In operating systems and support software, "IBM is raising prices as fast as it can get away with, and it's going to continue to do that because it has no viable competition."

According to Gartner Group projections, software will be a $61 billion business for IBM by 1995, accounting for 28% of revenues, up from 8% of its 1985 projected revenues of $50 billion (see bottom table, p. 29). By comparison, Gartner Group foresees revenues from IBM's mainframe and peripherals business falling from half of its business today to only 36% of 1995's total revenues of $220 billion.

A key question for IBM today is whether it can sustain growth in demand at a rate to justify the $33 billion investment it made in plant, equipment, and research and development over the past five years, Cohen says. Indeed, he notes, with those investments, IBM management made a large bet on elasticity of demand—that the more price goes down, the more demand goes up.

IBM product shipments have grown explosively over the past three years, fueled by conversion of mainframe sites from batch to on-line systems and the astounding proliferation of the IBM PC (sales have tripled every year since the introduction of the original PC in 1981, to about 1.6 million units last year).

The surge in mainframe shipments shows up in the strong growth of the computing power measured in millions of instructions per second. IBM saw mips shipments grow by an average of 45% annually over the past four years, up from a 36% annual average from 1977 to 1980. But the conversion from batch to on-line is largely over.

IBM faces tough Japanese competition on its home turf

What would support a 50% to 60% growth rate in terms of mips shipments to central user sites? "If you ask IBM, there are a couple of major factors," Cohen says. The first is an IBM drive to place a PC-based work station on virtually every desk. And once every desk in the world has a PC, there will be a need to connect them all with local networks and private-branch-exchange equipment. That will create very complex systems that will need to be managed. "In the IBM world, network management is the job of the mainframe, under SNA.

That's what's going to generate demand," Cohen says.

The second factor in the IBM equation is projected growth in office and departmental systems. The support that these systems need also will fuel central-site mips growth.

Cohen believes, however, that IBM is running at least a year behind on both plans to boost mips growth. When it "bungled" the transition to the PC AT because it relied on a single disk-drive vendor who couldn't deliver, PC shipments plateaued, he says.

IBM may bet stronger on volume to make up for margin declines

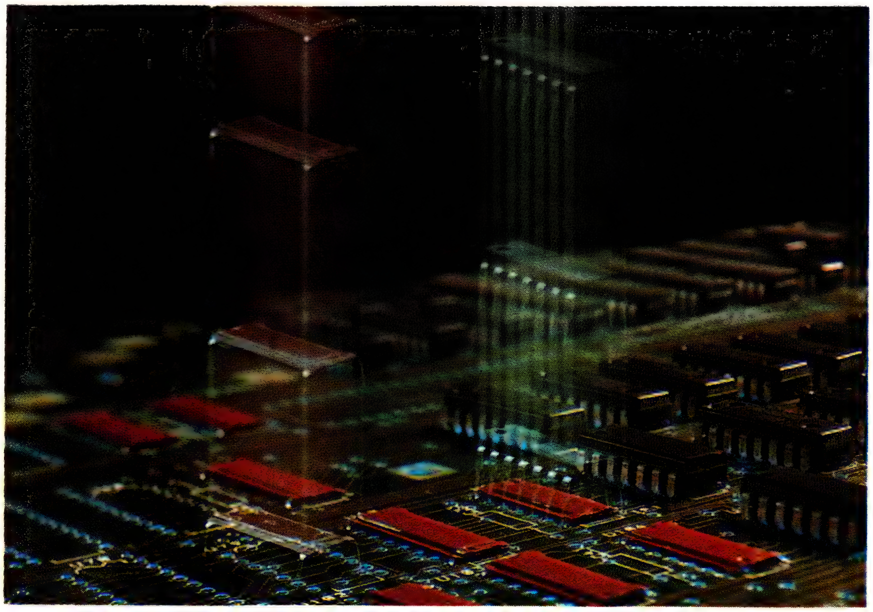
The slowing proliferation of PCs, coupled with IBM's failure to introduce its long-awaited 4-Mb/s token-ring local net for tying them all together, has in turn hampered the emergence of departmental systems. IBM's disparate array of five different product line offerings in that arena has also been a drag, causing confusion among customers.

Cohen believes IBM management may be concerned that growth in demand may not be what the company projected when it invested massively in its business. If demand growth is indeed slowing, IBM has two options, Cohen says. It could slow down price-performance improvements to boost its margins and get a return on its $33 billion investment. Or it could continue to bet on demand elasticity by maintaining historical price-performance improvements, or even accelerating the rate, hoping that volume will make up for margin declines.

Although the first option is more conservative, Cohen believes that IBM perceives it has no choice but to follow the riskier second course. This is because of the Japanese, who have access to relatively cheap capital and manufacturing prowess. "The Japanese have the best combination of factors to be a major threat to IBM," he says.

"I think IBM will be only partly successful in squeezing their expenses down because they're getting closer and closer to the breaking point," says Cohen. "Many large users are already beginning to complain that the support they are getting is not what it used to be and that perhaps it's not justifying the premium prices that IBM charges."

The result is that over the long haul, IBM will fall short of its goal of growing profits at the same rate as revenues, Cohen says. Between now and 1995, he expects that IBM could increase revenues by almost 16% annually. But IBM's earnings could grow about 1% slower than revenues. – *Wesley R. Iversen*



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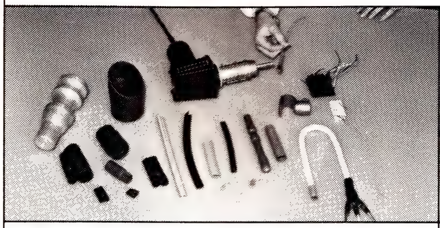

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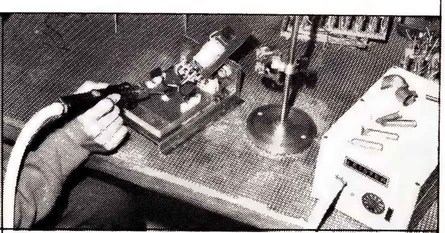

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Texas make

As Collins Avionics and Singer-Kearfott developed JTIDS*, the new communications system for the F-15 fighter, Texas Instruments helped solve a severe circuitry packaging problem.

The new system utilizes the most advanced chip packaging technology, the leadless chip carrier. Design objectives called for 191 components to be surface mounted on both sides of a 6″ × 8.5″ printed circuit (PC) board—and to dissipate up to 40 watts of power.

But, during thermal cycling tests, the difference in the thermal coefficient of expansion (TCE) between the ceramic chip carriers and the conventional PC

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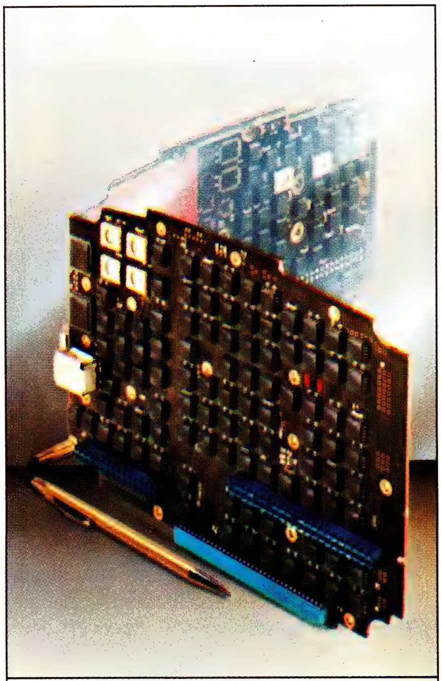
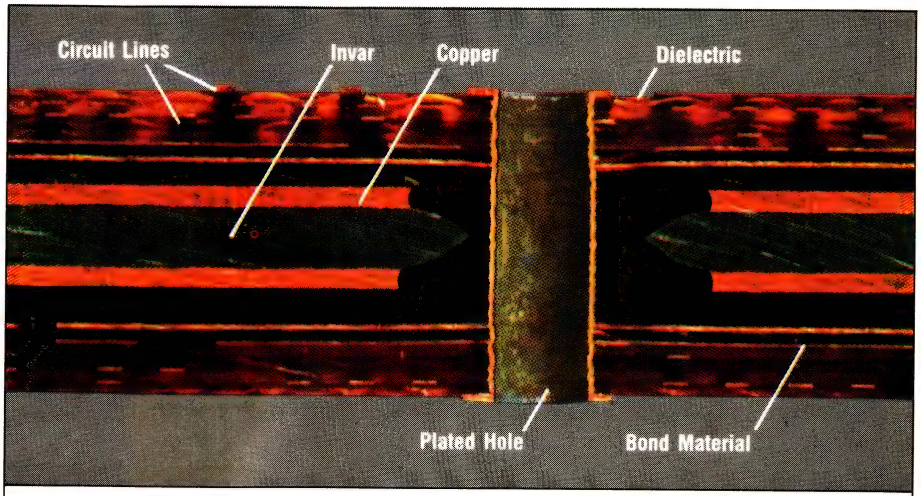
*Joint Tactical Information Distribution System



Successful application of high-density packaging was achieved in the PC boards of the F-15's new communications equipment. TI's clad metal system solved thermal expansion mismatch. This mirror-reflection photo shows how ICs were mounted on both sides of the PC boards.

◀ **Improved reliability** in the F-15's new communications system (JTIDS) is achieved with TI's copper-clad Invar used to prevent solder joint breakage on densely populated PC boards. TI teamed up with Collins Avionics and Singer-Kearfott to meet the demanding packaging requirements of the fighter's receiver/transmitter.

Instruments and Collins Avionics dense circuit reliability soar.



Effective thermal management is achieved with a copper-clad Invar core that acts as a support for circuitry in the PC board. Heat dissipation characteristics of the copper are excellent, and the Invar contributes rigidity and strength.

board caused the solder joints attaching the components to the board to break.

TI's solution: A composite metal core of low-TCE Invar that is clad on both sides with copper. Thin, polyimide-glass, multilayer boards were bonded to each side of the metal, to provide the circuitry function.

With a TCE match between the board and the chip carriers, the PC boards easily passed the exacting thermal cycling tests.

And the metal core in the board dramatically improved thermal conductivity and overall rigidity.

Solves thermal mismatch problems

As Collins Avionics discovered, the advantage of using chip carriers to achieve high-density, high-performance circuitry also imposes stringent demands for increased thermal management, structural integrity, as well as TCE compatibility—demands met by Texas Instruments copper-clad Invar.

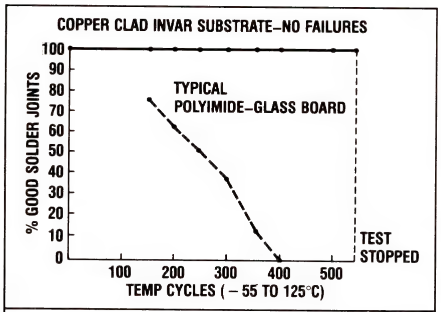
By combining TCE compatibility with high lateral thermal conductivity. And mechanical rigidity.

All at lower cost than alternate approaches.■

The solution is a trilayer metal.

TI's process involves roll bonding copper foil to Invar—a 36% nickel/64% iron alloy. The bonding to each side of the Invar is accomplished by the same process used to make thermostat metal and coins. No adhesives or brazing alloys are required to achieve a permanent bond.

By varying the ratios of the high thermal conductivity copper to the ultra-low TCE Invar, the TCE of the clad metal can be tailored to match that of silicon, alumina, or beryllia.



After 540 thermal cycles from −55° to 125°C failed to break chip carrier solder joints, Collins Avionics halted tests of PC board used in F-15 communications system. Reliability goals had been surpassed by a wide margin.

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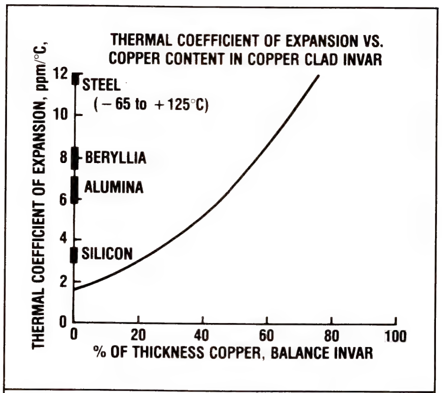
27-9216B



Matching the TCE of the metal core of a PC board to chip carrier ceramic is accomplished by bonding the correct ratio of copper to Invar.

This material is available in thicknesses from 5 to 62 mils (.13 to 1.57 mm). You can get it in widths up to 24 inches (610 mm).

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LASERS AND CHEMISTRY COMBINE TO TREAT CANCER IN EXPERIMENTAL THERAPY

by Denise Caruso

NOW IN CLINICAL TRIALS, LIGHT-SENSITIVE CHEMICAL REACTS WITH LASER LIGHT TO KILL MALIGNANT CELLS

PALO ALTO

A marriage of chemistry and electronics has given birth to an experimental treatment for cancer that could greatly improve early detection and treatment of the disease. Called photodynamic therapy, or PDT, the treatment is undergoing clinical trials by the U. S. Food and Drug Administration. Although the pace of these trials is accelerating, PDT has received little public attention to date.

The ingredients of PDT are pumped dye lasers, fiber optics, and a light-sensitive chemical made from cattle hemoglobin, called hematoporphyrin derivative (HPD). When injected in a cancer patient, the chemical remains in malignant tissue long after the body's metabolic processes have purged it from normal tissue.

After a specified period, a technician beams laser light—tuned to a 630-nm wavelength within a precision of 2 nm—directly on or into the malignancy, usually without surgery, through optical fibers. In a process not yet fully understood, HPD reacts with both light and the body's molecular oxygen to kill the cancer cells. It leaves normal tissue unharmed; the only known side effect is sensitivity to sunlight.

The specifications for the laser's wavelength are not easy to meet and leave little room for variation. The original application of laser light with HPD was a cancer-detection technique, using the violet light of krypton lasers to fluoresce malignant areas. But as a treatment, HPD will work only with light in the 628- to 632-nm range. In addition, for any useful penetration the laser equipment must put out 2 to 4 W—either continuous wave or pulsed—so the cells receive approximately 50 mW/cm^3 of light, the amount needed for maximum effectiveness.

More than 2,000 patients worldwide have been treated with PDT since controlled experiments on humans began in 1976. The results are promising:

- For metastatic breast cancer, 60% to 70% of local tumors treated disappeared completely.
- For basal-cell carcinomas—such as skin tumors—70% to 80% disappeared completely, 20% to 30% showed a partial reduction (50% by volume).
- For lung cancer when the disease hasn't spread, the tumor disappeared completely in 13 out of 14 patients. The treatment partially reduced the tumor in the remaining patient.

Daniel Doiron, director of the Western Institute for Laser Therapy, Santa Barbara, Calif., is one of a few professionals authorized to use PDT in treating patients. The nuclear and chemical engineer, who specializes in biomedicine, began working with the treatment in 1976 as a graduate student studying under Thomas J. Dougherty. Dougherty, a PhD chemist at Roswell Park Memorial Institute, a cancer-treatment center in Buffalo, N.Y., started championing PDT to the FDA nearly 20 years ago; the agency approved the current trials in 1976.

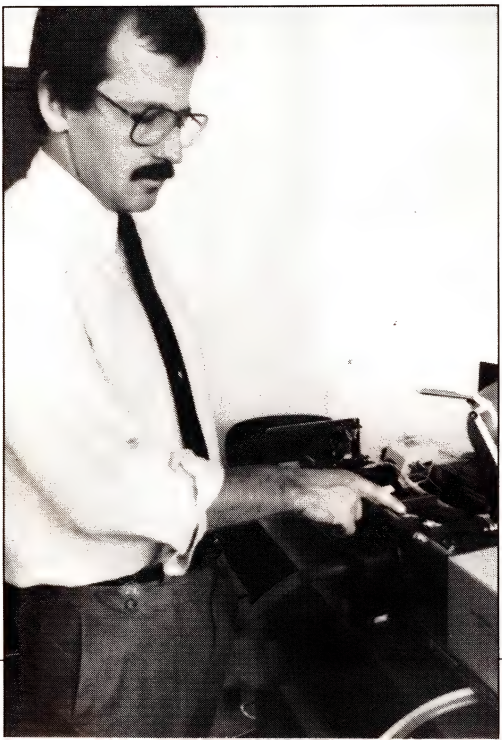
Since then, Doiron says, he has treated more than 60 patients and developed a line of fiber optics through his company, Laserguide Inc., Santa Barbara, to be used with PDT lasers. Other institutions using PDT in clinical trials include Baylor University Medical Center in Dallas, Tokyo Medical University, Wellman Laboratory at Massachusetts General Hospital in Boston, and the Mayo Clinic in Rochester, Minn.

Doiron and most other scientists working with this treatment use argon pumped dye lasers, despite the equipment's bulk and expense. A medical system for PDT that utilizes argon dye lasers can run $75,000 to $120,000. That does not include the high cost of electricity as well as fees to a technician, who must stand by to constantly tweak the laser to perfect pitch. Like many researchers, Doiron anxiously awaits the day when the more dependable solid-state lasers can perform the same exacting functions for a fraction of the cost and hassle.

The ideal PDT light source for HPD, he says, would provide the required wavelength of 630 nm, along with 5 W cw or pulsed at 10 kHz or faster. It would be 20% electricity-efficient, use 110 V ac, be air cooled, require only a monofilament for 80% to 90% fiber efficiency in delivery, and be highly reliable and easy to use. Also, it would cost $10,000 to $30,000—cheap enough for any hospital or clinic.

Argon lasers provide the necessary wavelength and power output but at a tiny 0.02% efficiency—using a 440-V three-phase line that taps into a hospital's main power source. They require water cooling and constant tweaking.

But in Oxford, England, a small company founded eight years ago by four physicists



OPTIC ENTREPRENEUR. Daniel Doiron has developed a line of fiber optics to be used with PDT lasers.

from the Clarendon Laboratory at the University of Oxford has developed a line of metal-vapor lasers that could be used in PDT. Oxford Lasers Ltd.'s lasing mechanism is a vapor of metal or gold heated to around 1,500°C in a plasma discharge tube.

The laser produces a pulsed 10- to 12-kHz output beam up to 40 mm in diameter. Oxford Lasers has produced a portable air-cooled model that simply plugs in. Measuring around 4 by 1 by 1 ft, this system consumes approximately 2 kW and delivers an output of 10 W. Systems sell for $39,000 to $58,000.

NOT OPTIMISTIC. As for the solid-state solution, Doiron does not think someone will walk up tomorrow and plop his dream chip on his desk. "The technology just isn't there yet for visible diodes. And there won't be any research money available for developing them inside companies until the treatment is approved" by the FDA.

Nonetheless, interest is growing in developing such diode lasers. That is due mostly to the efforts of Egon Loebner, a physicist at Hewlett-Packard Laboratories, Palo Alto. Loebner claims that inexpensive light-emitting diodes now on the market meet some of the criteria for use with HPD.

Loebner was taking a course from Doiron on PDT last spring, when it became apparent to him that LED technology could be applied to PDT, especially for treating surface cancers. "Without using optical fiber, a supersized LED or an array of LEDs could conceivably be used to treat superficial cancers. In the long run, one could build special collars or patches of LEDs, mounted on flexible material and put right next to the body. At that range, the local brightness is enough."

He is also excited about possible applications for technologies coming out of Japan. NEC Corp., he says, has had some success in developing an injection laser that performs within the specified wavelength, but problems with stability of wavelength and sufficient power output still persist.

NEC published a paper on the device in the Jan. 1, 1985, edition of "Applied Physics Letters." Company representatives would not discuss the matter further, however, saying only that they knew of no one "even remotely considering semiconductor lasers."

Also reluctant to talk about developing diodes for PDT is Spectra Diode Laboratories, San Jose, Calif., a leading developer of diode lasers for military, industry, and medical applications. "Any laser diode company is interested in the PDT application and has some program going on to develop visible laser diodes, whether for use with HPD or whatever," says marketing manager David Evans. Most of the scientists interviewed for this article mentioned the company as a developer, but Evans would not confirm that Spectra Diode has its own active program.

WANTS U.S. AID. This sort of reticence has Loebner and other scientists worried. He is afraid that without some kind of financial support from the government, PDT will still be too expensive to use by the time it receives approval.

Although the National Institutes of Health in Bethesda, Md., believes there is a "respectable chance" of PDT finding a niche in cancer treatment, the organization has been funding mostly HPD research, not laser research. There is an NIH funding program, Small Business Innovative Research, aimed at nurturing new laser technology, that has dispensed $500,000 per year to several companies. Initial funding consists of $50,000 over a six-month period. But only two or three of 30 funded proposals involve photodynamic therapy.

However, Alan Voss, director of new business development for Coherent Inc., Palo Alto, one provider of argon pumped dye lasers for PDT, thinks government funding of laser research by medical institutions would be a mistake.

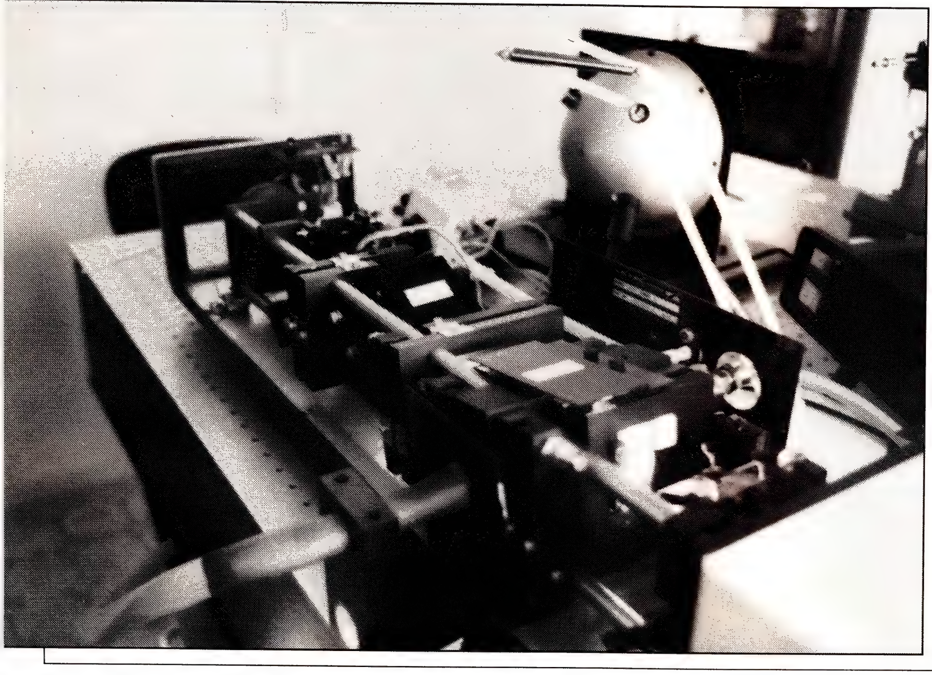
NO INCENTIVE. "Generally speaking, basic laser research of the type you're talking about can't be done by the medical industry," says Voss. "Other applications, like industrial and military, are so gigantic compared to us that there's no ballgame. We take the spinoff technology—YAG [yttrium-aluminum-garnet] lasers came from rangefinder technology used for tanks. For medical people to start from square one is almost impossible."

Bruce McCaul, vice president of new technologies for Cooper LaserSonics Inc. of Santa Clara, Calif., another provider of lasers for PDT, agrees. "We'd be happy to purchase reliable diodes," he says. "It would even be nice if we could manufacture them—we might try to motivate the semiconductor companies to design them, and we'd purchase them. But we just don't have the resources to fund that kind of research. We can't even sell the argon lasers except for experimental purposes until we get FDA approval."

If PDT indeed succeeds on what Doiron calls its "fast track" through the FDA's regulation process, within three years the treatment will be approved. Then, Loebner worries, patients and doctors nationwide will be clamoring for affordable PDT treatment systems that may not be available.

"Let's assume that PDT tests positive and this is really a way of treating certain cancers without detriment to tissue," he says. "We would like that to be available to as many people as possible. And I just don't see why a company [developing diode lasers] should take full financial risk. The government, or those who will benefit, should also take some risks. I am talking about this to get the word around and to needle people who can help do something about it." ☐

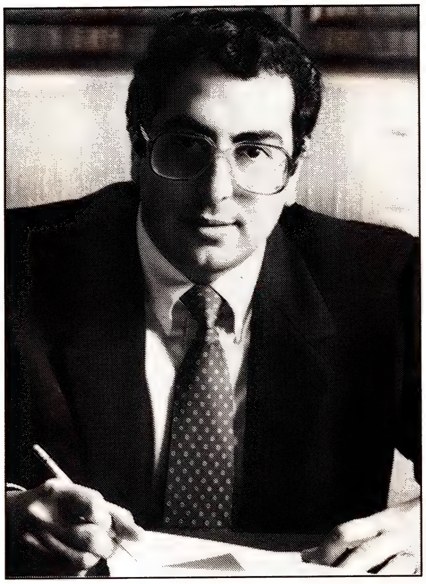
PRECISE. Laser must be tuned to 628- to 632-nm range for treatment to work.



PLAYERS

ASHTON-TATE THRIVES IN SLIDING MARKET

Acquisition of Multimate would give it best-selling programs in three major markets



BUYING. Multimate is the latest purchase by Ashton-Tate president Edward Esber Jr.

CULVER CITY, CALIF.

The current slide in the personal computer business appears to have bypassed the major software houses—so far, at least. As their weaker brethren fall victim to hard times, some companies are coming up with healthier market shares. One of them is Ashton-Tate, which is now halfway through a fiscal year that promises to be far and away the best in its five-year history.

The producer and marketer of the hot-selling data-base management package dBASE III saw its revenue more than double—to $24 million in its first fiscal quarter, ended April 30, from $11.2 million a year ago. Profits soared to $2.35 million from $149,000 a year earlier—and financial analysts say the Culver City company's upswing should continue (see tables).

For all fiscal 1986, industry analysts believe the company could earn $10 million to $12 million, compared with fiscal 1985's $7.5 million. This optimistic view doesn't take into account the company's planned acquisition of privately owned Multimate International Corp. Ashton-Tate agreed last week to acquire the East Hartford, Conn., company for a total of $19 million in cash and stock.

TWO JOLTS. Less than a year ago, Ashton-Tate suffered two jolts that left it tottering, or so it seemed to observers. Cofounder and chairman George Tate died suddenly from a stroke last August. Several months later, David C. Cole, the company's president and free-wheeling dealmaker, left to become president of Ziff-Davis Publishing Co., New York.

"Some people were predicting the company would go under," recalls Edward M. Esber Jr. A former IBM Corp. engineer who also holds a BS in computer engineering and an MSEE, the 32-year-old Esber was named president and chief executive of Ashton-Tate late last year; he had been the company's marketing vice president.

What saved the day for Ashton-Tate was dBASE III. The new version of the company's data-manipulation software is faster and manages data better. It is also in the favorable position of having little competition. The product consistently gained market penetration, even in the teeth of the personal computer recession.

Ashton-Tate's Framework, a multifunction integrated package that includes spreadsheet, word-processor, financial-analysis, and graphics capabilities, also has performed well in the marketplace, though not up to earlier inflated expectations. The mainstay dBASE III and the newer Framework account for 64% and 20% of revenue, respectively. The remainder comes from other, older products, such as dBASE II.

Esber believes Ashton-Tate has pulled off a coup that eludes most software companies. "We're one of the few to have best-selling products in two major markets"—data-base management and integrated spreadsheets. Acquisition of Multimate's popular word-processing software would give Ashton-Tate a best-seller in a third major market.

"People underestimate the importance of having such solidly established products during a chaotic market period," says one financial analyst who follows the software market closely. "There's more momentum to the established products than people give credit to."

Though Esber takes no credit for Ashton-Tate's key products, which were in place before he took over, he has deftly exploited them by installing basic management practices for financial planning and cost controls. These practices were sorely lacking in the past, observers say.

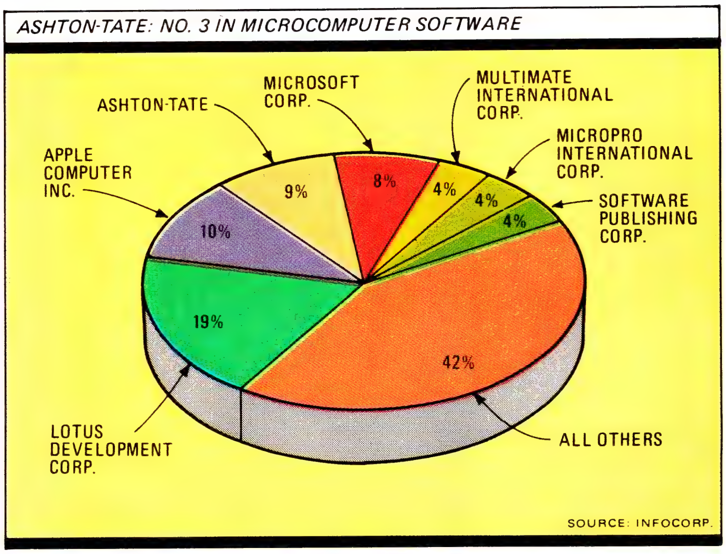
NEW BLOOD. Within months of assuming the helm, Esber named key managers to direct other improvements necessary to a smooth-running business. But unlike Esber, a founder of Visicorp, these executives seldom had much experience with software companies.

Nonetheless, they quickly began to have a major effect on Ashton-Tate. They streamlined manufacturing by farming out assembly work, beefed up customer service for quicker response to calls, and strengthened relationships with dealers, a critical growth factor. Esber also worked on improving internal communications; his success in this area has boosted company morale much higher than it had been during turbulent 1984, insiders point out.

"He's a solid manager, in control financially, concentrating on management and product expansion," says Carmelo J. Santoro, chief executive officer of Silicon Systems Inc., Tustin, Calif., and a director of Ashton-Tate. In Santoro's view, Ashton-Tate is well positioned for further growth.

Despite the company's notable gains, the future by no means promises unimpeded clear sailing, as Esber admits. The overriding problem is the challenge all microcomputer software outfits face: profitability. Most software companies have one mainstay product, which pays off with profits bunched into a fairly short period, compared with hardware's longer market cycles.

ASHTON-TATE: NO. 3 IN MICROCOMPUTER SOFTWARE



SOURCE: INFOCORP.

Ashton-Tate's dBASE is a prime example, as is Lotus Development Corp.'s 1-2-3. But both companies succeeded in leveraging their software into new and improved products. By contrast, Visicorp could not do the same with its once-runaway success, Visicalc, which flamed out under intense competition from next-generation integrated software packages.

EARNINGS STREAMS. "We have to find out how to convert these earnings spurts to earnings streams," says Esber. Whether by acquisition or by internal product development, a software business has to keep expanding and upgrading its offerings or fall by the wayside, industry observers point out. "It amounts to remaking our business every 12 to 24 months," Esber explains.

Director Santoro sees Esber's management of Ashton-Tate's future in similar terms. "He has to take dBASE and expand in a cohesive manner."

Santoro approved of Ashton-Tate's decision to acquire the remaining 85% of Forefront Corp., Sunnyvale, Calif., Framework's developer, in the first quarter. The move made sense, says Esber, because it expands the development strength available to improve Framework, and the two groups have proved they can work well together. Similarly, the move to buy Multimate will help Ashton-Tate expand its product line even further, Esber says.

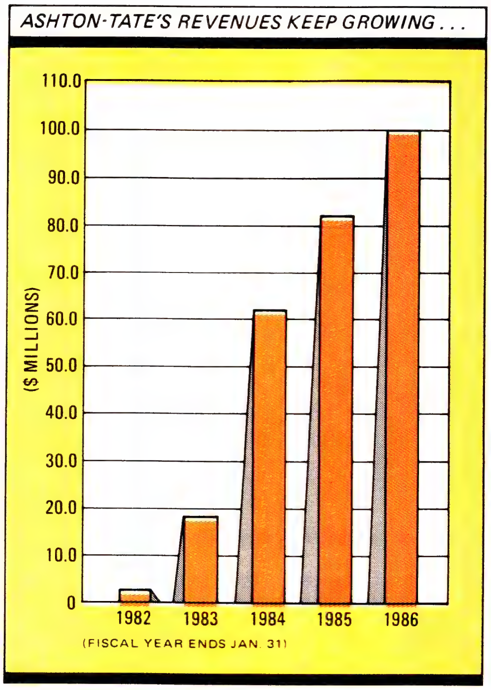
The pricing of software products also remains an unsolved question that nags all participants. Despite dBASE III's recommended retail price of $695, for example, most dealers discount this to about $400. Because Ashton-Tate sells the product to dealers for $350 (garnering the company a 10% profit margin), dealers still make money, but the level could erode further from dog-eat-dog retail competition.

For the software supplier to raise prices, it must give more service, which is expensive. One possibility is direct selling, which is expensive. But Esber thinks some company will "try it on a selective basis [to certain niches] soon."

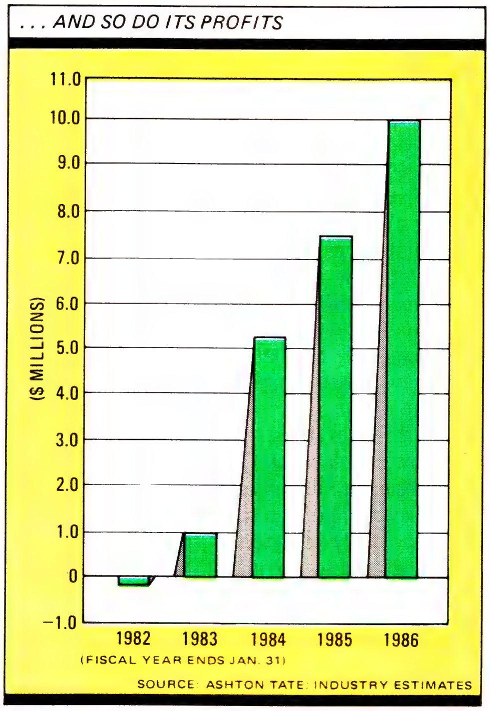
As for new ideas for software products, the recession in the personal computer market has helped here, too. When times were better, innovators with promising products started their own companies, often in the proverbial garage. "Now the 'Big Four' get the first look" at new software products, says Esber, referring to his company as well as to Lotus, Software Publishing, and Microsoft. "The dreams of entrepreneurs have been altered," he says. "They don't want to be an Ashton-Tate or Lotus anymore, but [they want to] work for us."

For the future, Esber plans to keep concentrating on "management basics," and to plow more money into research and development to further evolve current products. The company's R&D budget reached a high in the first quarter at some 8% of sales, or $2 million. However, revolutionary software, or truly easy-to-use programs, is still a way off. Even Esber admits that personal computer software "sometimes can be really hard to use." *–Larry Waller*

ASHTON-TATE'S REVENUES KEEP GROWING . . .



. . . AND SO DO ITS PROFITS



SOURCE: ASHTON TATE, INDUSTRY ESTIMATES

BOTTOM LINES

TEKNOWLEDGE FORMS NEW ALLIANCES

Teknowledge Inc., a developer of expert-system software, has raised $7 million from—and formed "strategic business relationships" with—two more large corporations. Nynex Corp., New York, invested $3 million in the privately owned Palo Alto company, and Procter & Gamble Co., Cincinnati, added $4 million. General Motors, FMC, Framatone & C., and Elf Acquitaine had previously made equity investments in the four-year-old software company.

Nynex, one of the Bell operating companies spun off from AT&T Co., plans to incorporate technologies developed by Teknowledge into its support systems, a representative says.

NIXDORF INVESTS IN PYRAMID TECHNOLOGY

Nixdorf Computer AG, Paderborn, West Germany, has invested $6.5 million in Pyramid Technology Corp., the maker of 32-bit Unix-based, reduced-instruction-set superminicomputers. Nixdorf has also signed an original-equipment-manufacturing agreement with the Mountain View, Calif., company, worth about $35 million over the next five years. The deal calls for technology exchanges and joint development efforts. The German firm will also provide field-service support for Pyramid products in areas of the U. S. not served by Pyramid. Nixdorf plans to remarket Pyramid's 90x series of computers as part of its own family of Unix-based products.

CUSTOM SILICON INC. COMPLETES FINANCING

Custom Silicon Inc., Lowell, Mass., has obtained $2.75 million in new venture capital and long-term debt financing. Founded in 1983, the maker of application-specific integrated circuits has a CMOS technology license and sourcing agreement with NCR Corp., Dayton, Ohio, which provides it with preferred access to NCR manufacturing resources.

INTERLEAF RAISES MORE EQUITY FUNDING

Interleaf Inc. has raised $7.5 million in new equity funding, bringing to $15.5 million the amount of money raised since its founding in 1981. The Cambridge, Mass., company develops electronic publishing systems and software. "The new funds will provide the proper equity base for the rapid growth Interleaf is experiencing," a company representative says.

PLAYERS

HOW FUNES SWUNG THE IBM-MEXICO DEAL

MEXICO CITY

The Mexican government's approval of IBM Corp.'s revised plan to operate a wholly owned subsidiary in the country [*Electronics*, July 29, 1985, p. 14] may be looked upon as sweet victory for Guillermo Funes. As the general director of technology transfer and foreign investment in the Ministry of Trade and Industrial Promotion, Funes often acts like a veteran salesman, and his pitch these days is that Mexico needs foreign investment for financial revival as well as for technological development. Funes says computers and related electronics fields are a priority area for this investment.

PITCHMAN. Guillermo Funes is a salesman pitching Mexico to the IBMs of the world.

But last January, when Mexico rejected IBM's initial bid to establish a 100% foreign-owned microcomputer assembly plant, foreign businessmen questioned the government's willingness to really promote foreign investment. They maintained that the regulators had won out over the promoters, and many questioned whether majority foreign concerns would ever be allowed in the microcomputer field.

As it turned out, there was little cause to worry. Funes, the promoter, also is executive secretary of the National Commission on Foreign Investment, which rejected IBM's original proposal. He favored that decision because, he says, the computer giant failed to offer Mexico its best technology.

NO SECOND PLACE. Funes, a tall, strapping man who speaks almost perfect English, says of his goals, "IBM has the best technology in the computer field. They're a leader, and I want the leaders here. But I also have my objectives as a Mexican, and I promote the things I'd like to have here. Second place doesn't exist in this game."

Funes has also identified the software field as important for development. On recent trips to the U.S., he has met with officials of Hewlett-Packard, IBM, and other companies in an effort to interest them in coming to Mexico. The results: Funes predicts that more foreign companies will soon want to go to Mexico, and that Mexico will begin exporting to a $600 million Spanish-speaking software market.

Funes asks several things from foreign firms—that they develop local suppliers, provide them with permanent assistance programs, and provide grants and scholarships for research.

Critics of the policy say that Mexico is merely participating in product assembly, that foreign firms coming to Mexico will continue importing semiconductors—the manufacturing technology that Mexico really needs. Funes replies that Mexico is simply not ready to tackle chip production, that there is still room for technology transfer in assembly, and that he is encouraging firms interested in the manufacture of some components to come to Mexico.

"But we have to be very clear," Funes emphasizes. "We've lost the main train, and now we have to jump on and find a market niche where we can. In 10 years, we'll be in a position to really negotiate." *–Leslie Layton*

FRANÇOIS SEEKS ENCORE AT COMPAQ

DALLAS

Just as a tripod does, a startup needs three sturdy legs to stand a chance of success in today's hotly comptetitive electronics equipment markets, says C. Murray François, the head of Compaq Computer Corp.'s telecommunications subsidiary.

The 42-year-old president of Compaq Telecommunications Corp., says a startup must first identify its market, then develop distribution-channel strategies, and finally develop its product. Without this support, he believes that new ventures cannot hold up.

All three of these legs are now in place at Compaq Telecommunications, he believes. The 16-month-old subsidiary is attempting an encore to Compaq's unprecedented success in IBM-compatible personal computers. Late in July, Compaq Telecommunications shipped its first volume production units of the Telecompaq, a desktop machine that it labels a telecomputer. The system, which is intended for corporate managers, combines voice and data communications into an IBM PC-compatible unit.

OPTIMISTIC. C. Murray François thinks desktop computers combining voice and data communications will boom.

With Telecompaqs aimed at more than 4 million managers in 129,000 large- and medium-sized businesses, François believes telecomputers must have different distribution channels from the traditional personal-computer retail outlets and dealers.

INTERRUPT HABIT. That's because telecomputers are intended to be integral parts of office phone systems, allowing managers to quickly review and forward documents as well as tap data bases over standard phone lines, he says. Comparing managers' work habits with the software term "interrupt-driven," François quips that "managers are interrupted driven." The telecomputer, positioned to intercept the PC as it grows from its initial base of professionals to one of managers, is designed to fit that habit, he explains.

François, a native of Louisiana's Cajun region, graduated from the University of Southwestern Louisiana with a bachelor's degree in physics. In 1964, he joined General Electric Co. and two years later moved to a new computer-equipment division that Texas Instruments Inc. formed in Houston.

In 1979, he joined an office-product development team—the Office Systems Division—formed in Dallas by Mead Corp. The plan was to advance the state of the art in ink-jet duplicators. François became general manager before Mead closed the operation in 1983.

Shortly thereafter Compaq established the telecommunications subsidiary in Dallas and recruited François to run it. He recalls that Compaq president Rod Canion "felt there was a strategic need to investigate what was apparent at the end of 1983—the emergence of telecommunications in computing."

Sales of desktop management systems are expected to be slow but steady compared with mainline PC sales. Much of the telecomputer growth will result from an emerging PC-replacement segment expected to account for most sales late in the 1980s. For management levels, François cites industry projections for telecomputer sales of $1 billion to $3 billion during 1988-89, compared to $25 billion estimated for total sales of microsystems. *–J. Robert Lineback*

UP AND COMING VS. UP AND RUNNING

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SMART POWER ICS MOVE FROM PROMISE TO PRODUCTION

by Howard Bierman

NEW PROCESSES COMBINING LOGIC AND HIGH-VOLTAGE DEVICES MAKE POSSIBLE A HOST OF NEW CHIP DESIGNS

Circuit designers have long talked about combining logic and high-voltage devices on the same chip, a capability that would open up a host of new applications for integrated circuits in industrial control and electrical appliances. Now, thanks to recent advances in processing technology, designers are moving out of the talking stage. By taking advantage of improved isolation techniques, for example, they are producing a growing flood of smart power chips that incorporate dense CMOS logic, high-precision bipolar linear circuits, zener diodes, oxide and junction capacitors, and junction or polysilicon resistors with bipolar or MOS high-power devices.

As a result, the growth in applications for these smart power devices is exploding. They already include motor controllers, off-line switching power supplies, fluorescent ballasts, hammer drivers for printers, electroluminescent flat-panel-display drivers, telecommunications interfaces, voltage regulators, and test equipment (Fig. 1). In addition, the low-cost power ICs enable high-frequency ac generation for improved motor efficiency.

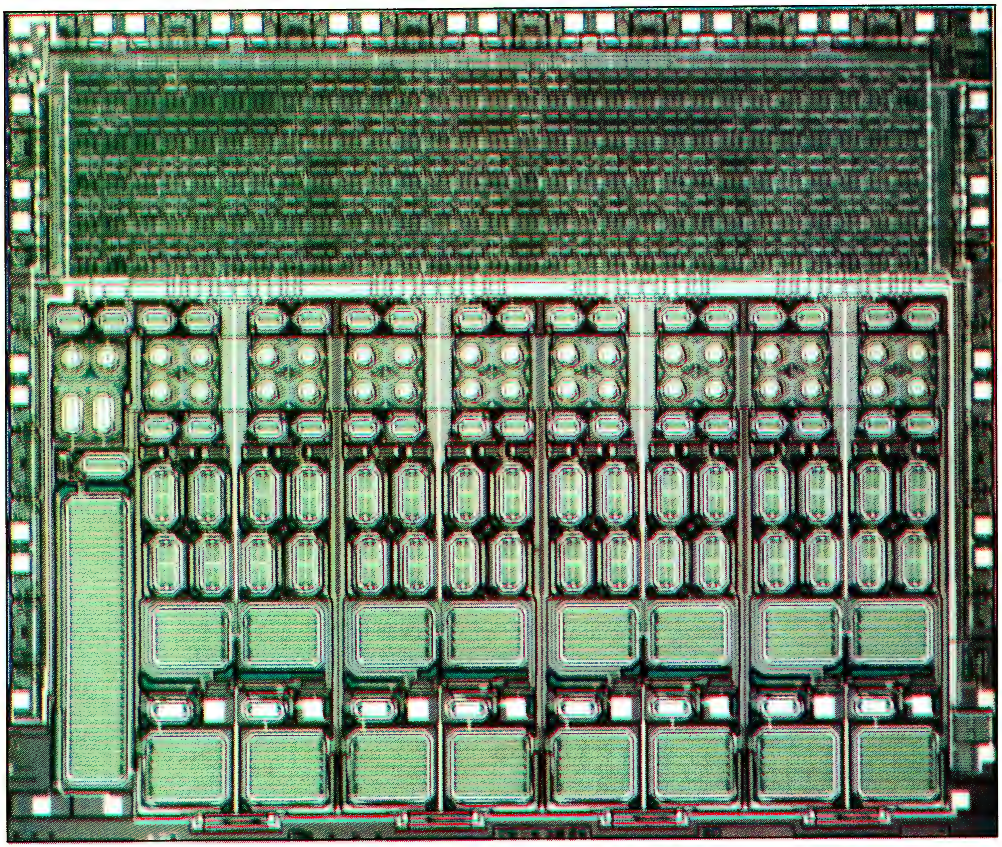
The new power ICs have led to novel dc motor designs such as General Electric Co.'s variable-speed dc motors with a built-in solid-state control. The market for such chips could be huge. The average U.S. household can have up to 50 motors in such appliances as air conditioners, washing machines, furnaces, and clocks. These appliances rely mainly on 60-Hz ac motors, the largest single user of electrical power in the country and considerably less efficient than dc motors.

The market for smart power ICs could grow from $8 million in 1985 to $80 million in 1986, says Arthur E. Fury, marketing vice president at Siliconix Inc. By 1992, sales could hit $1.2 billion, says James Barlage, semiconductor analyst at Smith Barney Harris Upham & Co., a leading N.Y. investment firm.

Semiconductor makers, as a result, are jumping quickly into this market. Companies busily designing integrated power chips range from such giants as Texas Instruments Inc. and National Semiconductor Corp. to smaller makers such as Telmos Inc. and Supertex Inc. They have been joined by recent startups Texet Semiconductor Corp. and Integrated Power Semiconductor Ltd.

These companies are making heavy use of improvements in bipolar power ICs, which came about from the recent emergence of semiconductor production equipment that can handle sharply reduced emitter widths and base dimensions. Bipolar ICs, heavily dependent on the npn transistor structure, can suffer from poor silicon-area utilization, collector-to-base breakdown, secondary breakdown, and the limited amount of space required for isolating various circuit elements.

Because the maximum voltage a bipolar transistor can handle depends not only on the collector-base junction breakdown voltage but also on the effect of current gain, designers must compromise between the voltage a device can handle and its ability to provide adequate gain. Secondary breakdown—a destructive process caused by nonuniform current density that causes hot spots—can be controlled by adding junction FETs



1. HIGH-VOLTAGE CHIP. Telmos Inc.'s 285-by-240-mil chip has 300 CMOS logic gates and 88 transistors for 500-V operation. The chip, in high-volume production since early 1985, is used in a bare-board tester.

or resistors to limit destructive current, but these contribute power losses and heat.

Manufacturers are also refining self-isolation, junction isolation, and dielectric isolation—the three basic approaches to isolating bipolar low-voltage logic transistors from high-voltage high-current MOS devices. Self-isolation in MOS technology takes place between the source and drain pn junctions when they are reverse-biased. In junction isolation, a buried layer is formed by implanting n-type impurities in a lightly doped p-type substrate. Next, a lightly doped epitaxial layer is grown, followed by boron and phosphorus diffusions to form p-regions that isolate the n+ regions from each other in the p-substrate. The pn junction's high resistance effectively isolates the regions.

Dielectric isolation

For voltage levels exceeding 150 V, the area needed to isolate individual transistors with reverse-bias junctions, or junction isolation, becomes excessive. Dielectric isolation offers a feasible alternative. In this approach, an insulating layer of silicon dioxide encloses each active area, which is then imbedded in polycrystalline silicon for mechanical strength. Each device has its own tub of single crystalline silicon and is isolated from other devices by a thick layer of silicon dioxide. To fabricate a bipolar IC with dielectric isolation, one side of the n-type silicon (which will be the bottom of the chip) is etched deeply to form a sidewall pattern upon which silicon dioxide and polycrystalline silicon are grown to form etched moats. Next, the opposite side of the wafer is polished to create insulating sidewalls at the wafer surface. Conventional diffusion and metallization steps finish off the structure.

The advantages of dielectric isolation include freedom from parasitic silicon controlled rectifiers, which cause latchup problems; extremely low substrate leakage currents, even at elevated temperatures; the ability to include JFETs or MOS transistors as well as thin-film resistors on the same chip; reduced transistor collector-to-substrate capacitance; and vertical pnp devices with bandwidths up to 12 MHz, versus 1 MHz with junction isolation. The drawback is the added cost.

A number of approaches combine low-level logic with high-voltage high-power technology. Texas Instruments, Sprague, and Unitrode integrate bipolar and MOS technologies. Using standard junction-isolation techniques, Texas Instruments Inc.'s process can integrate npn and pnp bipolar, CMOS, double-diffused MOS (DMOS), and JFETs on the same chip. The process is called bid-FET (for bipolar-DMOS-FET); TI devised it to manufacture ac plasma drivers. Interface output buffers using this technique have voltage-handling capabilities extending from 70-V bipolar npn devices to open-drain DMOS transistors with breakdown voltage greater than 400 V. Further, DMOS structures do not encounter the destructive secondary breakdown and thermal runaway hazards of conventional power bipolar devices.

The isolation region also works against the efficient use of silicon area in bipolar technology. To adequately isolate neighboring n-type pockets, p+ diffusions are formed around them with the width of the isolation generally twice its depth. High-voltage devices require additional depth, considerably raising the silicon area allocated solely for isolation.

SGS Semiconductor Corp., Phoenix, Ariz., has developed an ion-implanted up-down technique [*Electronics,* May 31, 1984, p. 87] that disperses the n+ buried layer, reducing the thickness between the base and buried layer as well as reducing the breakdown voltage. One recently introduced SGS product that uses this up-down technique is the L296 bipolar switching regulator. The 160-W device accepts inputs from 7.5 V to 50 V and delivers 5.1 V to 40 V regulated output. Efficiency is as high as 90%, versus 70% offered with linear regulators.

Another supplier of switching power regulators that use bipolar technology is Lambda Semiconductor Corp., Corpus Christi, Texas. Lambda's chips put out up to 30 V with output current up to 8 A. The chips perform temperature compensa-

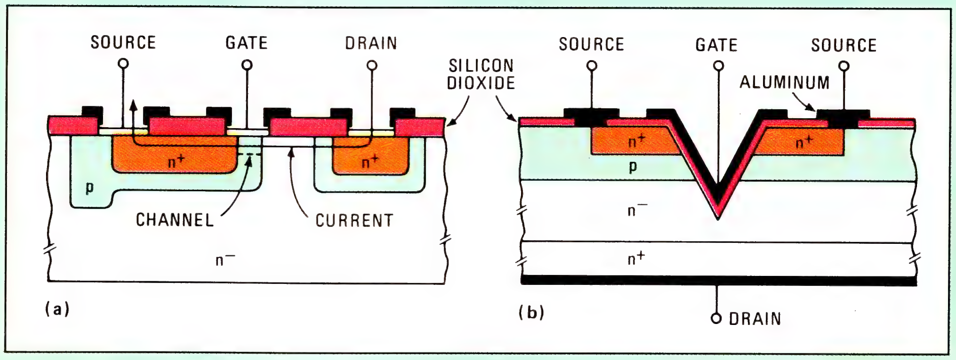
HOW POWER MOS FETs SHAPED UP

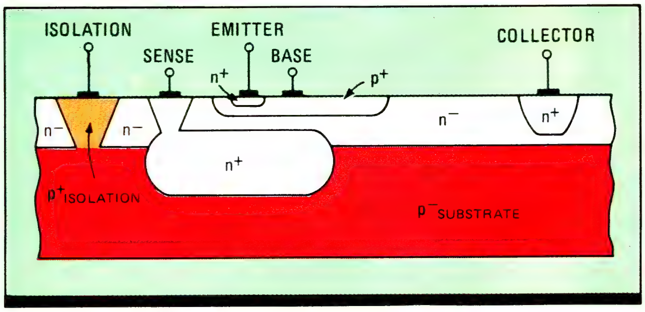
A conventional small-signal lateral n-channel MOS FET structure includes two lightly doped n+ regions diffused on a lightly doped p-type substrate. The n+ regions act as source and drain, with a channel separating the two. Power MOS FETs became feasible with the advent of self-aligned, double-diffusion techniques and short channel lengths, which permitted higher current density. The use of a lightly-doped n+ region between the channel and the n+ drain boosted the level of reverse breakdown voltages (a).

These improvements led to the lateral double-diffused MOS FET structure, in which all device terminals appeared at the die's top surface. A major drawback of this process was the inefficient use of silicon area. By placing the drain contact on the back of the die and etching V-grooves through the double-diffused n+ and p regions, a MOS FET structure with low drain-to-source resistance was formed (b).

Motorola modified the V-groove structure in its TMOS power MOS FETs by using a gate made with polysilicon sandwiched between two oxide layers, and applying the source metal over the entire active area to produce a high-voltage, low on-resistance device. Because the resistivity of n-type silicon is half that of p-type, n-channel MOS FETs require only half the silicon area of p-channel MOS FETs having the same on-resistance, and thus cost less than p-channel devices. Also, p-channel power devices suffer from the low mobility of the hole majority carriers—five times lower than electron mobility—which again results in higher resistance for a given chip area.

By paralleling the number of small cells making up an n-channel power MOS FET, higher current with lowered on-resistance is possible. Examples include Siemens AG's 50-V, 12-A Econofet MOS FETs, which have an on-resistance as low as 0.12 Ω, and Siliconix' VN series, which can handle up to 250 W with only 0.035 Ω at 100 V. **—H. B.**





2. HIGH-VOLTAGE DISGUISE. Although General Electric's transistor behaves like a high-voltage npn transistor, it is actually a low-voltage npn in cascode with a lateral high-voltage FET.

tion, current limiting, and thermal shutdown.

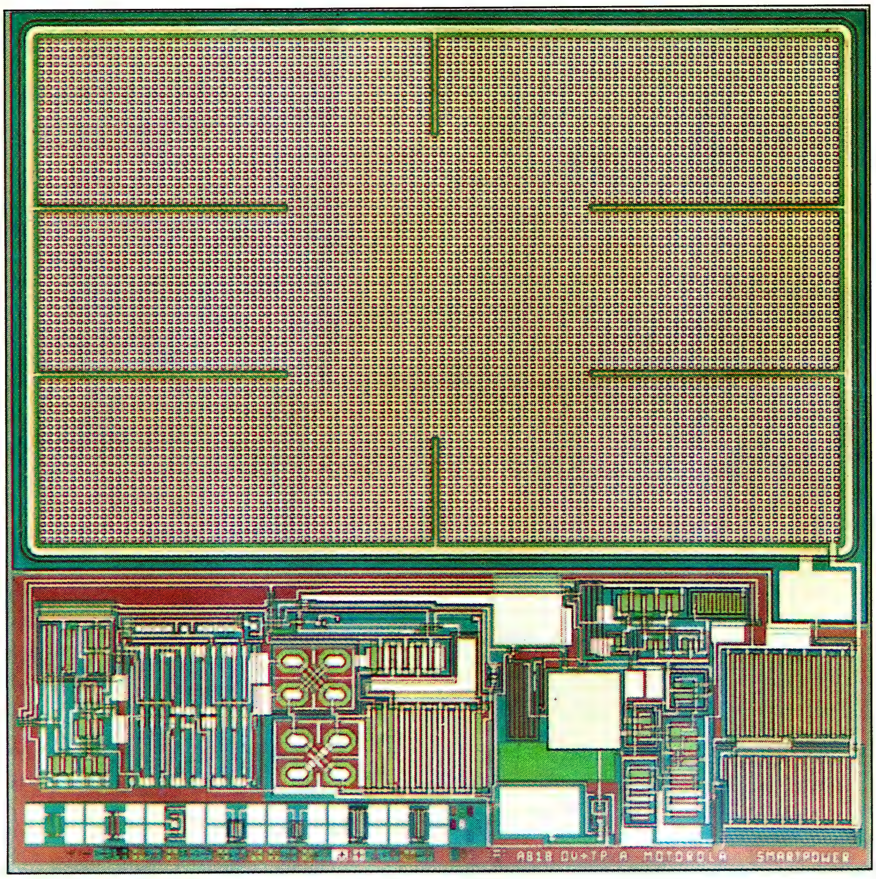
For its linear voltage regulators, National Semiconductor Corp., Santa Clara, Calif., uses a heavily doped n+ buried layer and a p-type epitaxial layer to isolate and optimize silicon area. A separate transistor in the structure supplies the required heavy current through the n+ substrate to the back surface of the wafer. National used the technique to produce the CM396 linear voltage regulator, which incorporates current-limiting, thermal-shutdown, and power-limiting functions.

High-voltage bipolar-MOS

General Electric Co.'s Discrete Semiconductor Device Center, Syracuse, N.Y., uses junction isolation in a 500-V bipolar-MOS process technology that can implement a wide variety of analog and digital functions on a chip. The company has a vertical npn bipolar transistor for in-house use, with gain between 25 to 40 and a 25-V open-base breakdown voltage, that offers an F_t of 5 MHz. Its lateral-pnp counterpart has a gain of 40 at low currents, open-base breakdown of 40 V, and an F_t of 1 MHz. GE built both parts with a standard polysilicon-gate technique; each can withstand up to 20 V of drain-to-source voltage. The process produces a wide range of resistor values with breakdown ratings exceeding 50 V; also possible are high-quality voltage-independent gate-oxide polysilicon capacitors and diodes rated above 50 V.

An important requirement for design engineers is the ability to reference any of the low-voltage devices up to 500 V relative to the p-type substrate potential. For example, a low-voltage pn diode contained in an n+ tub and separated from the isolation region by a predetermined distance can operate several hundred volts above the substrate potential as long as operation does not exceed the diode's internal breakdown limits.

The GE low-voltage npn bipolar in a cascode arrangement with a lateral high-voltage JFET is a good example (Fig. 2). With the emitter, base, and isolation grounded, the vertical npn transistor is normally off while the lateral JFET sense and collector regions are normally on, allowing the sense node to track the collector potential as it rises from ground level. To operate the device in an active mode, the emitter-base junction is forward-biased. If the JFET is pinched off, no current will flow from collector to emitter; the n+ sense region will drop in potential, causing the JFET to turn on again. For a given emitter current and collector voltage, the sense potential self-adjusts to let current flow through the JFET. An experimental high-voltage IC GE built with this technology measures only 0.10 in. on each side but performs the function of a 1½-by-3½-in. board.



3. LOW-COST PROTECTION. Overvoltage transients and temperature extremes are monitored and controlled by Motorola's Smartpower MPC 2000 series, designed to handle 12- to 15-V buses with currents up to 35 A.

Telmos Inc. uses a different approach in its high-voltage ICs. The Sunnyvale, Calif., company incorporates 500-V n-channel, 500-V p-channel, and 500-V insulated gate thyristors on a chip that also carries conventional low-voltage CMOS transistors. The design uses a twin-tub structure with both n- and p-wells to prevent punch-through, which would otherwise occur because of the high-resistivity silicon required for high-voltage performance. Clock speeds up to 10 MHz are possible and, Telmos claims, the technique eliminates latchup despite the CMOS circuitry's proximity to high-voltage circuitry by using dielectric isolation around the input/output buffers. Telmos's 500-V devices control ink-jet and electrostatic printers and motors, and have applications in telecommunications and data-acquisition systems as well.

Motorola Inc. recently introduced overvoltage and overtemperature protection devices to handle 12- and 15-V buses with currents up to 35 A (Fig. 3). Motorola uses an arrangement that depends on the lateral electron flow involved in the vertical groove structure they call TMOS (see "How power MOS FETs shaped up," p. 41). In conventional double-diffused technology, precise lateral diffusion controls channel length. Motorola substitutes vertical diffusion to create a narrow channel with less drain-to-source resistance for higher breakdown voltage and higher current handling [*Electronics,* May 31, 1984, p. 87].

Based on CMOS logic combined with the vertical TMOS drive structure, Motorola's products protect voltage-sensitive systems and memories from overvoltage transients and temperature extremes. Because the device dissipates minimal power in the off state, the junction temperature is essentially the same as the case temperature, which ensures protection from wide temperature variations. With units priced below $1 each in large quantities, the MPC2004, 2011, and 2014 series offer an economical means for board-level protection.

Siliconix Inc. and Supertex are concentrating on DMOS FETs combined with CMOS. The industry until recently considered the CMOS-DMOS combination impractical because power MOS devices are more costly to fabricate than bipolar devices and because their on-resistance was deemed too high. In the past two years, however, process gains have cut the required die size for power MOS circuits and reduced their on-resistance to match that of bipolars. By employing a process that combines high-voltage (up to several hundred volts) lateral double-diffused vertical MOS devices with npn and CMOS transistors, Siliconix has introduced a flurry of Smartpower chips to market (Fig. 4).

SGS offers parts that use its Multipower-BCD process to combine linear, CMOS, and DMOS technologies. The process centers on a vertical DMOS silicon-gate two-level structure in which the lower level is a doped-silicon-polycrystalline gate and the upper level is the source metallization. The 10-mask process, SGS claims, involves noncritical manufacturing techniques with a standard junction-isolation process to include DMOS structures using the same profiles and polysilicon layer. The use of polysilicon gates improves reliability by minimizing the risk of sodium oxide contamination in the gate oxides and also stabilizes threshold voltages.

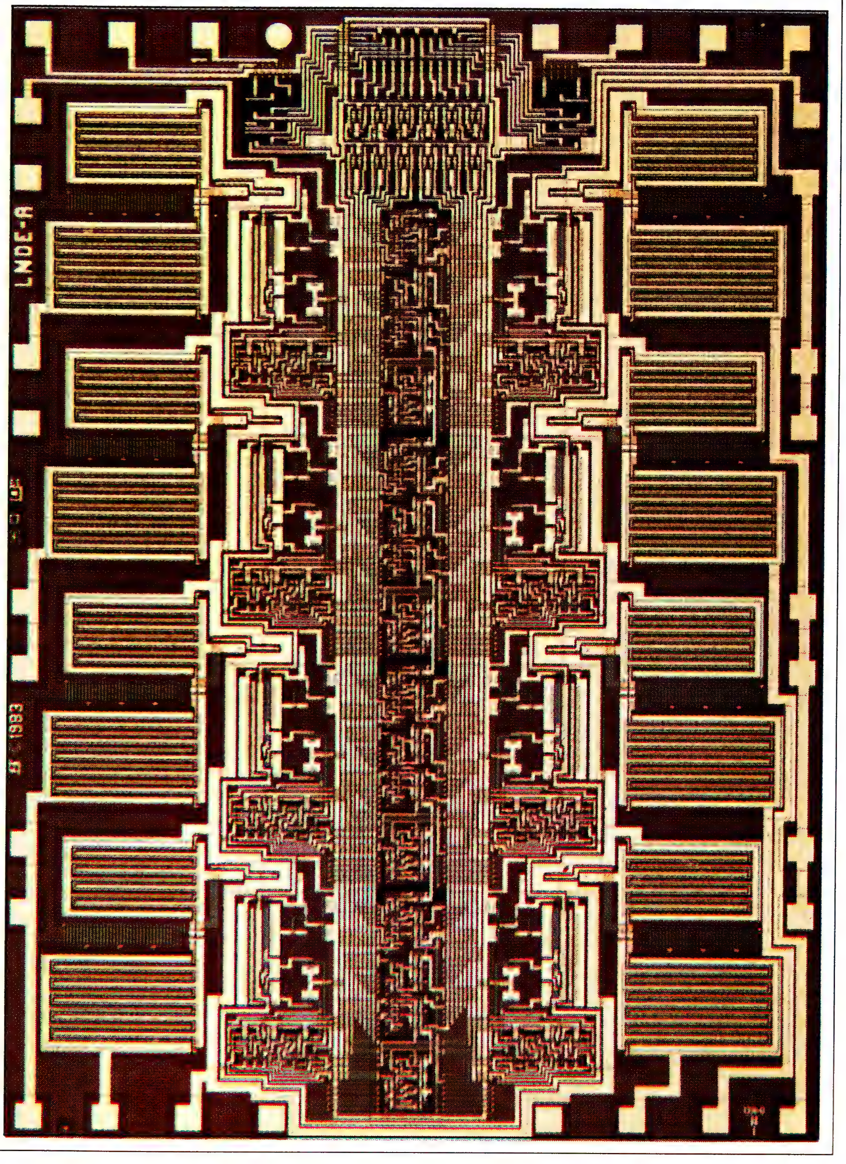
For switched-mode power supplies and switching applications, this process offers efficiency exceeding 95% with switching frequencies as high as 500 kHz. Thanks to the high efficiency of power DMOS, it is possible to put relatively high-power ICs in copper-frame dual-in-line packages such as SGS's Multiwatt, which handles power levels up to 400 W, the company claims. In addition, because increasing a power-DMOS transistor's area can reduce its saturation loss, designers have the option of trading bulky and costly copper and aluminum heat sinks for silicon, as wafer-processing costs drop with fabrication improvements.

Among the power ICs available from SGS is the L6212, claimed to be the most powerful switch-mode 6-A, 50-V solenoid driver on the market. With 250 W of useful power and compensating circuits for power-supply variations, shorts, and excessive temperature rises, the L6212 is intended for hammer driving in daisywheel printers and typewriters. SGS products still on the boards will handle 250 V for off-line switching supplies and telecommunications power converters for the U.S. market; SGS will have 450-V versions available for Europe, where line voltages run 220 V and higher.

Because of the additional processing steps required to include logic with high-voltage devices, 500-V ICs are generally twice as expensive as their discrete counterparts, claims Peter Schackle, marketing vice president of Telmos. Discrete transistors need relatively large areas of silicon and, as a general rule, the total area in a power IC is no smaller than that required for a discrete design. Thus the increased cost must be offset by the cost of packaging, assembly, and testing of one expensive device versus dozens or hundreds of separate discrete devices. The dollar cost of integrating power devices with logic depends on the voltage level and complexity of the logic circuitry. If there is only one high-voltage device or if several high-voltage transistors share a common terminal, full isolation is not needed. If the current demand is not excessive and required voltages are under 200 V, as in a subscriber-loop interface chip, several hundred small-current chips can operate in parallel.

Double-injection devices, such as thyristors, triacs, MOS-gated SCRs, and gated diode switches, do not follow the same scaling laws as power transistors, Shackle points out. For example, a 500-V 0.5-A thyristor occupies only twice the area of a 50-V thyristor with the same current rating. For this reason, thyristors are key elements in the high-voltage ICs produced by Telmos and Harris Corp., Melbourne, Fla. Both companies use dielectric isolation to separate the analog and digital control circuits from the power structures.

Although chip designers continue to seek devices with

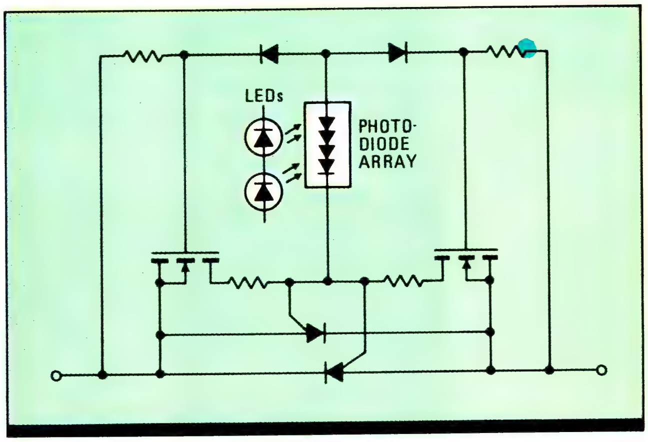


4. SMART POWER PACKAGE. The Siliconix DG568/569 Smartpower chip includes a 500-gate CMOS array together with eight 200-V MOS power transistors around its outer perimeter.

ratings above 500 V, semiconductor market researchers estimate that more than 50% of power-MOS applications will be for 100 V and below, primarily in the automotive industry for voltage regulation, lamp drivers, and engine control. Another major market segment will be battery-powered consumer products, such as tools and toys, where transient voltages occur less frequently than in power-line operation. For these applications, chip designers are concentrating on reaching such operating parameters as 30-V blocking voltage, on-resistance of 30 mΩ or less, and current ratings up to 50 A.

Lower-voltage chips

Texet Semiconductors serves this market with its "thirty-cubed" MOS FET, a 30-V, 30-A, 30-mΩ device in a TO-220 package. The TX30N03P provides full-rated current at a case temperature of 100°C, an economic advantage since many consumer designs reduce product cost at the expense of optimum heat-sink provisions. These new devices, coupled with pulse-width-modulation controls, can triple the useful life of a battery in a power tool.



5. TELECOM SWITCH. A single-chip high-voltage IC developed by AT&T includes two series connected LEDs as well as the photodiode array for 2,500-V input/output isolation.

Another product for low-voltage applications is Gould AMI's S4520 dichroic liquid-crystal-display driver, which supplies 30 V, rather than the 3 to 15 V used for twisted-nematic displays. The driver's higher voltage range gives dichroics two major advantages over conventional displays—wider viewing angle and high color contrast. Characters can be viewed from angles as wide as 180° by eliminating the polarizers that are used in twisted-nematic LCDs.

The driver also eliminates the tinting filters used for conventional LCDs. An on-chip oscillator, whose frequency is set by an external resistor and capacitor, provides the ac backplane signal. The user can replace the on-board oscillator with an external backplane signal if desired. The serial-input-latched driver accommodates up to 38 capacitor segments sharing a common backplane, and its CMOS design draws only 0.4 mA total current.

Research in display-driver technology has also been stimulated by the military, which has been eagerly seeking flat-panel displays to replace conventional cathode-ray tubes in aircraft cockpits and portable equipment. Considerable development effort in the integration of intelligent driver electronics for EL and plasma displays has brought products to market from TI, Siliconix, Supertex, Gould AMI, and Holt. These products deliver high-frequency high-power switching signals that extend the lifetime and improve the efficiency of flat-panel displays.

Two output configurations are applicable for flat-panel-display drivers; totem pole and open drain. Totem-pole output requires high-voltage leads to pass over insulating junctions, which tend to produce surface breakdown. But there is no need for high-voltage leads to pass over insulating regions with open-drain DMOS outputs, eliminating the possibility of surface breakdown. Typical EL flat-panel displays require 150- to 180-V levels, a demand that can be met with 250-V open-drain DMOS outputs.

TI applies its bid-FET process for the 200-V levels required for EL displays. CMOS logic controls DMOS devices, which in turn drive bipolar power transistors. Sprague Electric Co., Worcester, Mass., and Unitrode Corp., Lexington, Mass., both use the bipolar-MOS combination for parts with voltage levels up to 80 V for driving vacuum fluorescent displays, piezo elements, LEDs, relays, and stepping motors.

Supertex's HV03/HV04 chip set provides up to 64 channel row-and-column drivers per chip, an attractive offering for designers of EL displays. Their earlier products, HV01 and HV02, are 16-channel chips designed to drive panels with up to 1,000 by 1,000 elements; they include circuitry to handle 16 levels of shading in the created image and are targeted for the military rather than commercial market. The devices come in a hermetically sealed leaded chip carrier approved by the military. The 64-channel set, with on-board blanking and forward- and reverse-shifting options, does not provide gray shading but draws 60% less power than other available commercial driver chip sets, Supertex claims. The company plans to expand logic density in the drivers from 2,000 to 5,000 gates per chip and increase voltage-handling capability to 500 V.

Another supplier of drivers for dichroic LCDs is Holt, with its HI-8010 MOS p- and n-channel enhancement-mode devices that can drive up to 38 segments. Available in DIPs, leadless chip carriers, or dice, the device is loaded through a serial port; internal latches hold data until new display input is received.

AT&T Bell Laboratories, Reading, Pa., and Hitachi Ltd., Tokyo, use high-voltage ICs implementing dielectric isolation to interface subscriber loops with central-office switching systems. Though Hitachi uses an SCR and AT&T uses a gated diode switch, both approaches block positive and negative signals in the off state but conduct in only one direction when on. Either requires only a few milliamps dc to achieve a low on-resistance for ac signals.

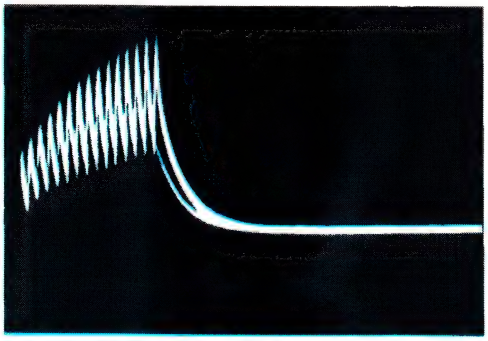
AT&T has developed a high-voltage IC that controls the switch hook in cordless telephones. Two series-connected LEDs isolate the switch from the control circuit (Fig. 5). The HV700A, a linear solid-state switch, uses dielectric isolation; it includes the photodiode array and a DMOS transistor to provide linear conduction as well as SCRs for protect against surges. The double-pole single-throw configuration requires only a 2-mA control current, offers 2,500-V I/O isolation, 10-A surge capability for a 1-ms pulse, and has 20-Ω on-resistance per pole.

Motor and relay applications

Harris's Analog Products Division offers an energy-saving chip that uses bipolar technology with dielectric isolation for induction motors. Induction motors run at a speed that is a function of supply frequency rather than of applied ac voltage and draw a fairly constant current regardless of the load on the motor. The motor responds to a load with a change in the power factor. The Harris HV-1000/1000A senses the load by means of the power factor and then supplies only enough voltage to meet the load requirement. The controller section of the chip triggers a triac placed in series with the motor to vary its root-mean-square voltage.

All analog processing is done at ac line frequency, with no dc involved. Dielectric isolation with 400-V junction breakdown is used with the junctions of the input regulator, and the SCR output stage is stacked to provide a composite breakdown voltage of 800 V. A phase-to-voltage converter measures the difference between a reference phase and the motor-current phase. This level determines the voltage applied to the motor. A clever design feature of this converter is its ability to anticipate and instantly correct any sudden changes, such as a sudden heavy load or an abruptly removed load, by monitoring any change in phase angle greater than a specified amount. The device can be used with machine tools, heat pumps, disk drives, industrial sewing machines, and many home appliances. The energy saver can also be a motor saver in industrial areas, where line-voltage fluctuations may cause excessive current through the induction motor; the HV 1000/1000A controller will prevent such damage.

Integrated Power Semiconductors Ltd., a Livingston, Scotland, company with U.S. headquarters in Santa Clara, is introducing its line of smart-power products aimed at such applications as power supplies, motor control, and solenoid drivers. One of its early designs, a dual-H bridge driver for stepper motors used as head actuators in floppy-disk drives and ribbon or paper feeders in printers, has potential application in robotics and plotters, the company says. Other offerings include a three-terminal voltage regulator with 1% output tolerance, contrasted with the conventional 4%, achieved with on-chip trimming performed at the die-sort stage.



6. UNWANTED INTERACTIONS. High-voltage ICs can be damaged by such problems during testing as high-voltage high-frequency oscillations (shown) and sharp spikes on the supply-voltage line.

MOS power devices are also challenging relays for industrial high-current applications. An early entrant in this area was Theta-J Corp., Wakefield, Mass., with an optically coupled relay consisting of a single LED and a dielectrically isolated IC. Two photodiode arrays switched the relay on by supplying drive to a bilateral output pair and turned it off by shorting the internal FET gates to the source. The device can withstand 300 V while supplying up to 200 mA with on-resistance as low as 10 Ω.

Photosensitive power chip

International Rectifier's Crydom Division, El Segundo, Calif., applied its bipolar-MOS technology to integrate high-gain photosensitive bipolar transistors, transient-suppression networks, a lateral thyristor output, and a zero-cross sensor on its innovative Chipswitch [*Electronics,* Dec. 29, 1982, p. 59]. Crydom mounts two identical power ICs on a ceramic substrate and connects them in an inverse-parallel fashion. Each IC controls a half cycle of the line ac power, producing an ac solid-state switch. Infrared radiation emitted by a gallium-aluminum arsenide LED activates the photosensitive power chips. Optical coupling in the encapsulated assembly housing these three elements performs the required high-voltage isolation. The series P Chipswitch claims 3,750-V rms isolation, 280-V breakdown at 1-A, and handles up to 30 A. It conforms to Federal Communications Commission emission requirements.

Crydom's BOSFET (bidirectional-output-switch FET) combines with a highly efficient photoreceptor to produce a normally-open solid-state replacement for electromechanical reed relays. The photovoltaic relay (PVR) includes a bidirectional MOS transistor with on-chip logic along with a 10-photodiode array and an LED. With the BOSFET optimized for extremely low gate capacitance, Crydom claims the PVR device can respond to only a few milliwatts of control power up to 10 times faster than its electromechanical equivalent.

A striking example of the effect high-voltage ICs will have on the electrical industry is the solid-state ballast produced by XO Industries, Mountain View, Calif., to replace magnetic ballasts in fluorescent lamps. Basically, a ballast performs three functions: to heat the lamp filaments, to supply sufficient starting voltage to initiate an arc, and to limit power once an arc has been established.

Conventional magnetic ballasts have a number of drawbacks. First, light output will decrease if lamp temperature drops below 40°C or if the line voltage drops. Second, low line voltage causes filament damage during starting, which shortens lamp life and reduces light output. Third, high line voltage can cause instant-start cathodes to burn off their emissive coating.

The XO ballast design, according to Ron Lesea, vice-president of research and development, had to overcome three challenges: first, designing an efficient interface between the device and the gaseous discharge lamp load; second, making the ballasts operate at efficiencies over 90%; and last, providing power factors as high as 95%. The XO design is an upgraded high-frequency power-supply switching arrangement applied to driving gaseous discharge tubes. The operating frequency is 55 kHz to limit harmonic radiation, although devices up to 200 kHz have been breadboarded (at 200 kHz, the length of the lamp makes it an efficient antenna). Too, the design's sinusoidal output reduces harmonics. XO decided to use power MOS FETs rather than bipolar devices because they don't suffer from secondary breakdown and thus offer higher reliability.

To upgrade the reliability of high-voltage ICs, engineers at Xerox Corp.'s Microelectronics Center, El Segundo, concentrate on reducing arcing within the package, minimizing surface-charge spread on the chip, and damage due to the test arrangements. Lead-to-lead arcing can occur with 450 V applied between leads spaced 1 mil apart at room temperature and atmospheric pressure; with 5-mil spacing, the application of 1,000 V will cause it to break down. Sharp bends in leads mean breakdown will occur at lower voltage levels. Although lead arcing is not a problem with DIPs, the pressure inside ceramic packages may be lower than atmospheric due to the sealing, and the possibility of failures due to arcing increase. To minimize the possibility of internal breakdown, bonding-wire spacing must be closely controlled and a polyimide may be used to passivate the chip's surface to insulate bond wires.

Xerox engineers point out that careful attention must be given to the possible failure modes of the high-voltage device as well as to the potential effects of the testing system. Because no commercial automated tester is currently on the market for testing high-voltage ICs (above 100 V), engineers must resort to home-brew systems. Two examples of unexpected difficulties with Xerox's test system involved oscillations at the chip's output and spikes on the supply-voltage line. In the first case, oscillations at 14 kHz with 200-V amplitude occurred when the disable lines, which were coupled capacitively to the outputs, were briefly opened as high voltage was applied to the chip (Fig. 6). In the second example, a sharp pulse on the supply line appeared when a contact from the power relay closed before the sense lead was connected. ☐

VLSI-CHIP TEST SYSTEM TESTS ITSELF AT BOARD LEVEL

MegaOne's dedicated hardware and intelligent software boost reliability and cut downtime

TECHNOLOGY TO WATCH is a regular feature of *Electronics* aimed at providing readers with exclusive, in-depth reports from companies around the world on important technical innovations. It covers significant technology, processes, or developments incorporated in major new products. The reports also provide analyses of technical data, so that readers can assess the impact of new developments. Richard Swan, director of engineering; Greg Kannall, hardware engineering manager; and Bob Miller, engineering project leader, made up the design team from Megatest Corp. in San Jose, Calif., that developed the very large-scale-integration tester described in this article.

Boosting reliability and minimizing downtime is a top priority for designers of any large, complex electronic system. By applying a proven self-testing technique employed previously at the chip level, a design team from Megatest Corp. accomplished just that with the MegaOne VLSI test system.

Test systems for very large-scale integrated circuits must satisfy two conflicting requirements. Because their high cost requires more of the IC test flow to pass through fewer testers, throughput must be much higher. Yet the reliability—measured in terms of reduced downtime—of systems that must test circuits approaching the picosecond range must be increased four to six times that of previous generations of testers.

The Megatest design team took a concept from circuit-level self-testing of VLSI chips—level-sensitive scan design (LSSD)—and built it into the test system. LSSD self-tests by breaking a circuit or system into logical groups of related functions and using the shift registers for each group to exercise them under control of the central processing unit.

The MegaOne VLSI test system (Fig. 1) uses LSSD at the board level rather than at the circuit level. The test system uses more than 500 independent scan paths and more than 5,000 scan chains to scan out intermediate pipeline levels through an independent diagnostic bus.

Because of the MegaOne's self-testing capability, it can verify every functional block in the chip-testing system. With it, the mean time to replacement of any board in this system is on the average less than an hour.

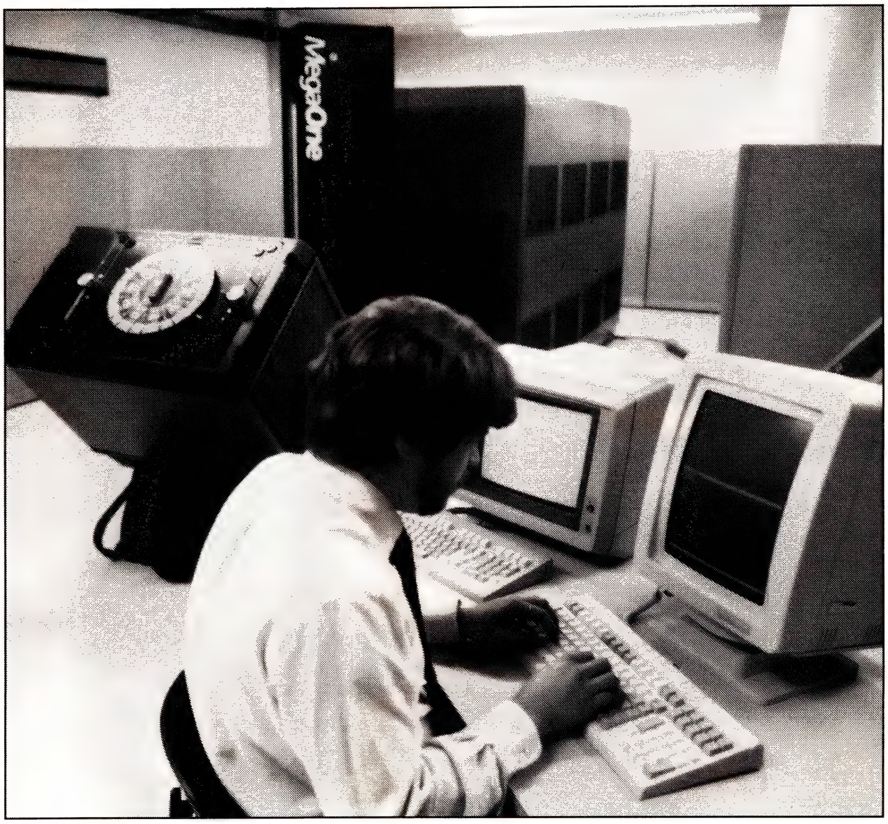
To support self-testing, the tester incorporates a number of other advanced self-testing capabilities. These include:

- An environmental monitoring unit, which monitors more than 700 points in a typical 160-pin system checking power-supply voltage, current, air flow, temperature, power ripple, and power fluctuations, as well as sequencing the power supplies as the system powers up.
- An expert-like intelligent diagnostics subsystem incorporating a set of comprehensive, user-friendly diagnostic routines that localize possible system malfunctions to the board level.
- An autocalibration subsystem (known as Autocal), which cycles the test system through variations of the possible timing-generator output and measures actual arrival times of the test signals at the device under test.

Traditionally, self-testing at the systems level in IC testers has been a patchwork affair. Engineers incorporate diagnostics and self-testing features on a module-by-module basis late in the system's design and construction phase.

Because the MegaOne's designers developed it with self-testing in mind, each board has up to 20% more hardware to support self-testability. Moreover, the company developed the overall test strategy and diagnostic procedures before building the tester.

Though this results in a system with more hardware, the investment produces several important benefits. The added hardware increases user confidence by reducing downtime and increasing reliability, the designers say. It also ensures a test system that goes to the user with considerably fewer undetected design flaws and hardware



1. EASY TESTING. The test engineer uses the MegaOne's multiple display screens to control the tester operation and write test programs. He can write programs on one display and monitor real-time operation on the other.

or software bugs. Finally, it speeds up the design process.

Having settled on the MegaOne's diagnostics and self-testing architecture before they did the actual hardware development, the Megatest designers could get immediate feedback about the quality of the design. Without such feedback mechanisms, the manufacture of the initial hardware would have moved more quickly, they say, but additional debugging of the hardware and reworking of the diagnostics software would have extended the total development and installation time.

In developing the tester, the choice of self-test methodology was as important as the decision to design in self-testing. Once Megatest had determined the basic design philosophy, it was clear that the test procedures built into other IC testers were inadequate for the job.

For example, traditional test systems usually use some sort of functional testing scheme. The internally generated function patterns are analyzed at the pin electronics using the parametric measurement unit.

Hardware testability

In the MegaOne, however, a tremendous amount of hardware lies between the source of the patterns and the signals being monitored (Fig. 2). Therefore, if something fails, the service technician faces a difficult troubleshooting task. Typically, the technician will use an oscilloscope, start extending the boards, and work his way laboriously back through the card cages and cables until he finds the problem.

In a small test system, the mean time to repair in a situation like this is reasonable. But in a VLSI test system such as the MegaOne, with as many as 60,000 LSI, VLSI, and discrete components and up to 250 boards, it is far too long. For an alternative to traditional techniques, designers at Megatest turned for inspiration to the very VLSI circuits they built the MegaOne to test.

VLSI-tester complexity and the associated problems of self-testing have direct parallels at the VLSI chip level. Their complexity makes it difficult to exhaustively exercise all the internal nodes to ensure reliability.

Of the self-testing alternatives, Megatest chose the LSSD approach for the MegaOne. In this approach, first proposed at the chip level by IBM Corp., the VLSI circuit partitions the test circuit into logical groups of related functions. Associated with each partition on the chip is a shift register composed of two level-sensitive latches. The first latch has two sets of data and clock inputs, one set for normal system operation and the other for shifting test data in and out of the latch. Thus the shift register can either present data to the storage elements for system operation or shift it through the register for testing.

Board partitioning

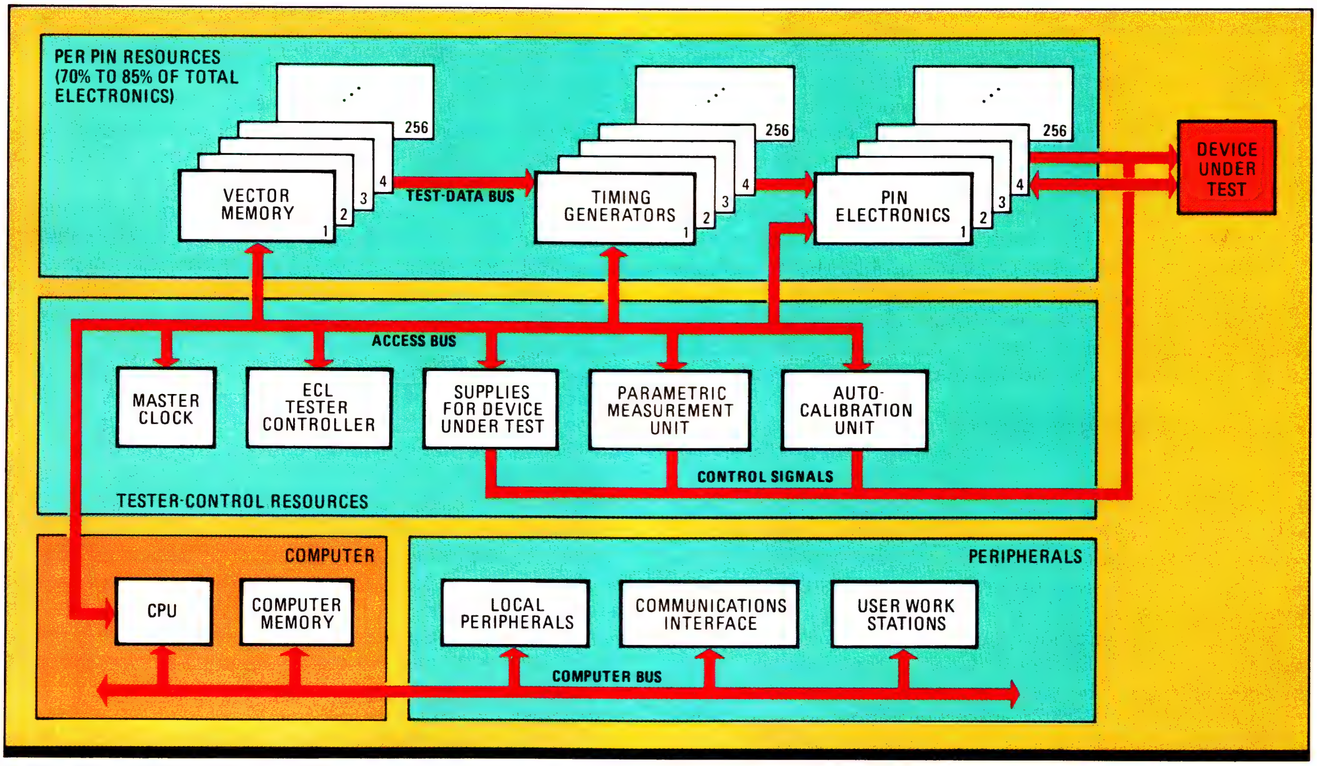
In the MegaOne's board-level implementation (Fig. 3), the tester partitions each board into blocks of combinatorial logic separated by pipeline latches. These latches allow for both parallel transfer during normal operation (that is, chip testing) and serial scan in and scan out in the diagnostic, or self-testing) mode, as is typically done at the chip level. In the MegaOne, however, bus-interface logic packages the serial data into 16-bit words for transfer to the CPU. In this way, the CPU can treat the LSSD port on any board as an additional location in its memory-mapped address space.

During normal operation, the system uses the functional data path and pipeline clock to implement each board function. In the diagnostic mode, it uses both the diagnostic clock and the pipeline clocks.

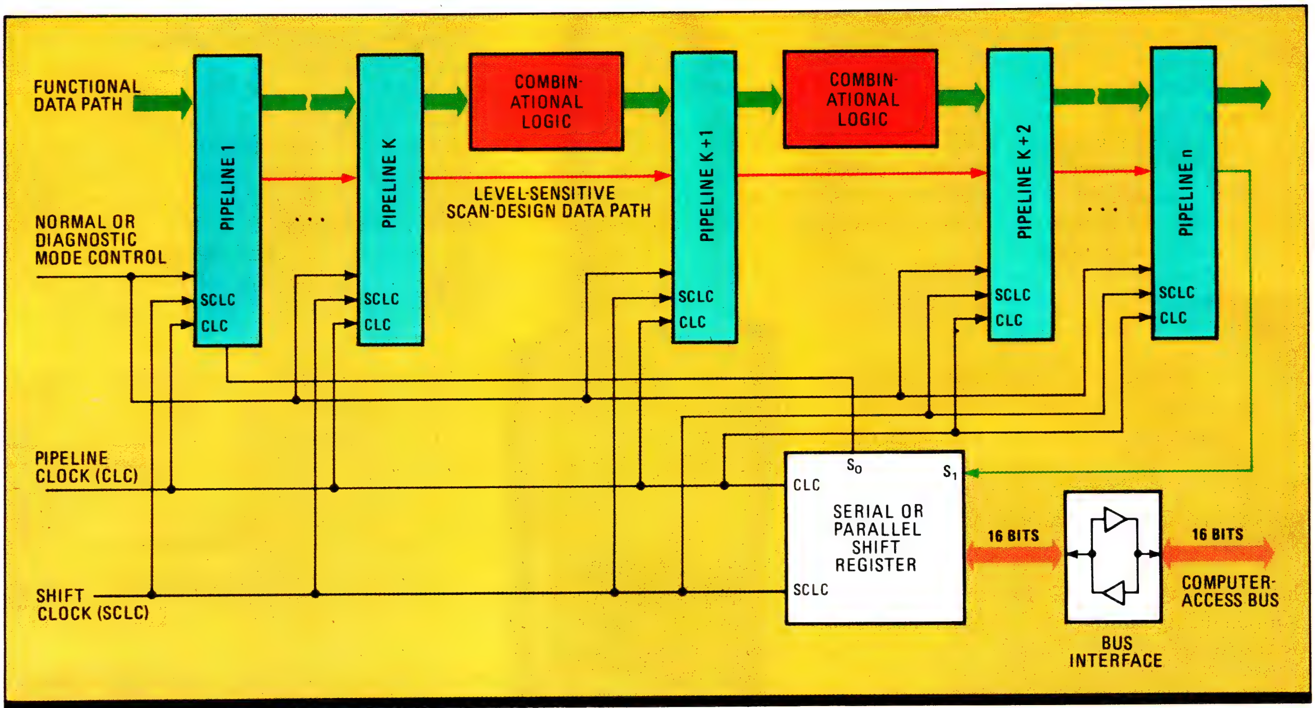
First, the diagnostic clock scans in data to each pipeline latch. Then the pipeline clock is single-stepped to transfer the information through to the next pipeline level. Finally, the diagnostic clock again scans out the latch information.

Then, if it is necessary to look at the pipeline level, the program shifts the data out, looks at it, and shifts it back without destroying the machine's state. Faster and less intrusive than other techniques, this approach also adds few or no additional wire connections to the system.

In another departure from a typical chip-level LSSD im-



2. MORE HARDWARE. The MegaOne has three major subsystems in addition to its own 32-bit 68010 microprocessor. These are the per-pin resources, the tester-control resources, and the system peripherals, containing more than 50 components and up to 250 boards.



3. BUILT-IN SCAN. The key to the MegaOne's enhanced self-test capability is the level-sensitive scan design (LSSD) on each of the boards in the system, allowing localization of virtually every possible board-level malfunction within less than an hour.

plementation, the pipeline clock can be programmed for a fixed number of full-speed cycles. This provides burst-mode testing of the logic. Usually, a burst of two is used to clock information scanned into pipeline level k to the k+2 pipeline level, testing both the setup and hold time of the k+1 pipeline at the full functional clock rate.

An important element in the self-test strategy upon which the MegaOne's design was based was the ability of the system to determine two conditions as quickly as possible: not only when a malfunction occurs, but also when it is about to occur. To this end, the MegaOne incorporates an environmental monitoring unit, which continuously monitors ac and dc power, airflow, and temperature. If the monitoring unit detects a faulty condition, it notifies the computer, which invokes a diagnostics program that attempts to localize the problem without shutting down the system. A correctable condition could also invoke the Autocal subsystem to perform any necessary recalibration. The entire system then returns to normal operation.

If the system cannot correct the problem—for example, if a component fails—the computer initiates an orderly shutdown of the tester and turns off power to the card cage containing the faulty module. The computer then alerts the operator to call up the diagnostics menu.

Incorporating intelligent diagnostics

VLSI testers, like VLSI circuits with built-in testing, require special software diagnostics. Traditional tester diagnostics consist of unrelated modules that check various parts of the hardware, all of which operate independently of one another. These individual tests are usually then tied together in various configurations to do subsystem and system-level tests.

In such implementations, however, these modules cannot talk to one another and provide intelligent feedback to the system operator. The result is inefficient performance and hit-or-miss fault coverage, governed mainly by the technician's knowledge of which diagnostics to run, in which order, and how to interpret the results.

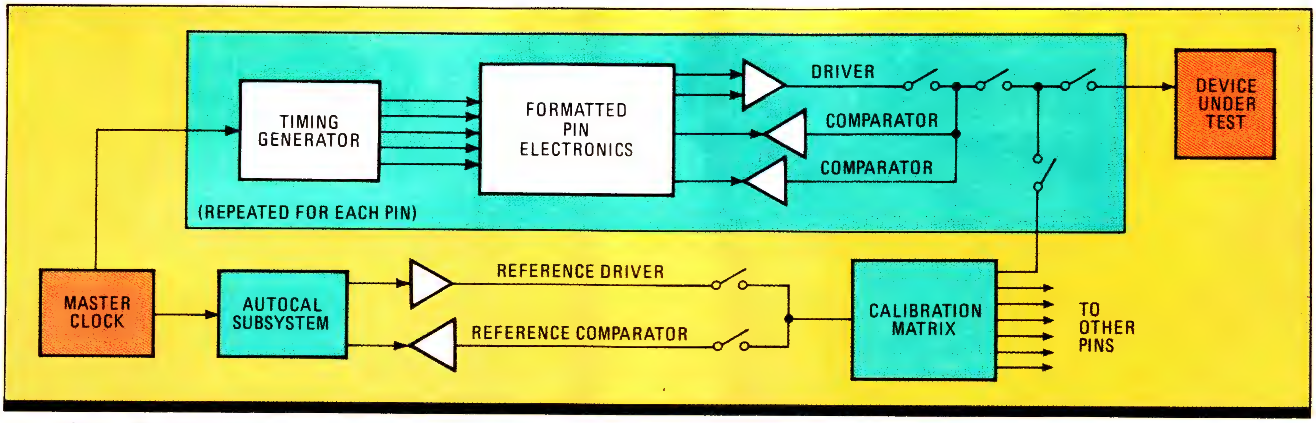
To solve this problem, Megatest's designers included an expert-like diagnostics program (meaning the system uses the engineers' expertise in developing the relational data base but without the inference engine used in an expert system). This intelligent program collects and stores enough information about the system—what the various functions are and how those functions interact—so that the system can test itself in the proper sequence and appropriate recommendations made. This program describes the relations in the tester in the following combinations:

- Between all major subsystems in the tester.
- Between each major subsystem and its constituent functional modules.
- Between the functional modules in each subsystem.
- Between each module and its constituent boards.
- Between the modules and boards and the various cables and data paths in the system.

The data base actually consists of several collections of data, each of which is mapped or overlaid on the others at the appropriate times. One set delineates the megastructure of the system—the complete system in a full implementation, its various components, how they are connected physically and functionally, and what the paths and signals are throughout the system. A second is the actual physical structure of the system as installed. A third collection is the set of relations that results when the first and second are mapped onto one another as the test system is initialized. Comparing the two, the system can tell whether any boards are malfunctioning.

A fourth set of data is a list of all available diagnostic routines and specifications of their fault coverage down to the function and path level. A fifth set of relations consists of test blocks and their prerequisite test blocks—the ones on which the former depend—as determined from the interrelationships of the functions and paths. Finally, a set of relationships defines various recommendation for swapping boards.

Based on these relations, the diagnostic software breaks down system testing into levels in which the higher the level number, the more comprehensive and the more de-



4. AUTOCALIBRATION. The Autocal subsystem self-calibrates, measures all physical signal-path lengths and and every signal path from the timing generators to the pin electronics, measures the pin-electronics delay, and generates precompensated timing tables.

tailed and exhaustive the testing. Level 1 is the system-level confidence test, derived from information obtained from the electronic monitoring unit and the Autocal subsystem. Level 2 divides the system into major test blocks. Level 3 divides these into smaller test-block subassemblies, consisting of two or three boards. Level 4 is the board level, where swap recommendations are made.

Below this, for use by the system technician and inaccessible to other, nontechnical users, are even lower levels dealing with functions and paths and with component-level fault isolation.

Driven diagnostics

To give the user full advantage of the MegaOne's intelligent diagnostics program, the tester incorporates a menu-based diagnostics driver for running various tests on itself. The modular driver runs checks at either the system or the board level. Chosen from the menu, the systems-level diagnostics evaluate all functional areas of the MegaOne, including signal paths and connectors between modules. The board-level diagnostics analyze the performance of specific circuit boards.

When the operator calls up the diagnostics driver, it initializes all hardware and displays or prints out all errors in a hardware configuration. After showing the hardware-configuration menu, the driver displays the top-level menu, from which the operator chooses the test to be executed. More specific modes are the execution mode, which determines how extensive the test is to be, and the report mode, where the operator chooses which data to examine from the test results.

In the execution-mode menu, the operator has the following choices:

- Executing selected test blocks and all untested or failed prerequisite tests.
- Executing selected test blocks and all pretests.
- Executing selected blocks only.
- Forcing execution of selected blocks and ignoring messages that hardware is missing.
- Stopping execution of any further tests after the location of the first failure.

From the report-mode menu, the user can direct the self-diagnostics program to report:

- Tests that fail.
- Tests that pass.
- Tests that fail because hardware is not present.
- Tests that are skipped because hardware was not present and which the test program did not expect to find.
- Tests that were skipped because lower-level tests were skipped or failed.

The autocalibration subsystem is the final element in the self-test strategy built into the MegaOne. This comes into play after the diagnostics have been performed to determine the functionality of each board in the test system. Using a high-accuracy calibration driver for calibrating pin-electronics comparators and a high-accuracy calibration comparator for the pin-electronics drivers, the Autocal subsystem ensures an overall worst-case system accuracy of 200 ps for individual driver edges and 225 ps for a comparator edge.

Taking advantage of the MegaOne's use of an independent timing generator for every pin on the device under test, the Autocal subsystem calibrates every possible timing-generator output (or edge) at every pin (Fig. 4). This aspect is the key to accurate autocalibration.

Most test systems send edges through a switching matrix to fan them out to the pins of the device under test. Because the possible permutations through this matrix is virtually infinite and because each permutation will have its own unique delay, these systems can never truly calibrate every path and every edge.

Autocalibration, the final step

By contrast, the MegaOne's one-pin, one-timing-generator design makes each path direct and unique, and thus each path can be calibrated precisely. The Autocal subsystem can cycle the test system through every possible edge and measure actual arrival times at the device under test to provide completely closed-loop autocalibration for any possible tester signal.

To do this, the pin electronics have a controlled-impedance relay matrix, which connects to the high-speed Autocal controller subsystem. With this matrix, the Autocal subsystem calibrates the system timing parameters. It also measures precisely the autocalibration distribution lengths and the electrical-path length from the pin electronics to the device under test by means of time-domain reflectrometry.

Software then accesses the measured parameters to close the loop and allows the Autocal subsystem to calibrate the full system. The signal paths from the pin channels to the device and those for the subsystem are custom-designed coaxial assemblies that minimize the total number of discontinuities between signal generation and the device pins. The Autocal subsystem's 20-ps accuracy and 3-ps resolution allow deviations in any of these signal paths to be compensated accurately.

Using three basic measurements—the timing-chain delay, the Autocal distribution delay, and the path length from the pin electronics to the device under test—the Autocal software generates a timing table that is used to precompensate timing as the tester works on a device. ☐

TEKTRONIX MAKES MAJOR COMMITMENT TO AI MARKET

It introduces two new computers and cuts price of existing model

HELPMATE. Tektronix' new computers use Motorola's 68020, assisted by the 68881.

Tektronix Inc. has added fuel—in the form of two new computers—to the artificial-intelligence fire. As the fascination with inexpensive, high-performance machines for AI applications grows, Tektronix is committing itself to the AI market by turning last year's single product into a family.

Price-performance ratio is the main emphasis of the Tektronix 4000 series. Introduced today, the 4405 and 4406 join the 4404 [*ElectronicsWeek*, Aug. 6, 1984, p. 84]. The company is also trimming the 4404's price—from $14,950 to $11,950—because the new 4405 delivers 25% to 50% more performance for the price of the 4404. Prices for the 4400 family are from one half to one quarter those of dedicated Lisp machines. Tektronix will exhibit the new computers later this month at the International Joint Conference on Artificial Intelligence in Los Angeles.

The two machines are powered by Motorola Inc.'s 68020 microprocessor, assisted by a 68881 floating-point coprocessor. The 4404 uses the 68010; current customers can order a field-retrofit kit to upgrade the 4404 with the new processor for $3,500. Both the 4404 and 4405 include a 13-in. screen with a 640-by-480-pixel viewable display window that can be panned anywhere over the 1,024-by-1,024-pixel addressable bit map.

These two systems also include 1 megabyte of main memory (expandable to 5 megabytes), 32 megabytes of virtual-memory address space, and a 45-megabyte hard disk.

The deluxe model, the 4406, has the same CPU as the 4405 but sports a high-resolution (1,280-by-1,024-pixel) 19-in. display. It also comes with more memory (2 megabytes), a 32-megabyte virtual address space, and a 90-megabyte disk. The 4406 will sell for $23,950.

All three systems have a package of bundled software that includes a Unix-like operating system, the Smalltalk-language AI programming environment, and a C language compiler. With this basic package of hardware and software, each model in the 4400 family can serve either as an AI software-development tool or as a system for application delivery.

At the same time, Tektronix is introducing the rapidly emerging standard Lisp language, Common Lisp, for the 4400 systems. The Tek Common Lisp is a full implementation of the standard language as documented in the text *Common Lisp, the Language*, by Guy L. Steele Jr. Working jointly, Tektronix and Franz Inc., an AI-software vendor, have optimized this standard for the 4400 family. Tek Common Lisp can optionally be licensed for $6,000.

One such enhancement—a 32-bit, object-oriented pointer space—allows the development and delivery of larger applications when using the 4405 and 4406. Other optional software items include Franz Lisp, MProlog, Emacs editor, a library of utilities and development tools for the Unix operating system, and a number of third-party software packages such as OPS 5, KES from Software Architecture and Engineering Inc., and Reduce from the Rand Corp.

The Tektronix AI-system family offers hardware options as well: memory to a total of 5 megabytes, incremental 90-megabyte disk drives, an Ethernet network interface using the Transmission Control Protocol/Internet Protocol, and a streaming tape drive. The machines' other standard features are an RS-232-C serial interface port, a Centronics-compatible parallel printer port, keyboard, and ANSI X3.63 terminal-emulation software.

Although the 4405, 4406, and Tek Common Lisp can be ordered now, Tektronix cannot schedule delivery before January 1986. *–Tom Manuel*

Tektronix Inc., P. O. Box 1700, Beaverton, Ore. 97075. Phone (503) 644-0161 [Circle reader service number 338]

VMEBUS BOARD RUNS PDP-11 SOFTWARE

Users of Digital Equipment Corp.'s PDP-11 minicomputer line often face a dilemma: DEC's dated Q-bus architecture can no longer provide the horsepower needed to take advantage of 32-bit microprocessors, yet most of the investment in debugged software is for the Q bus.

Software simply hasn't kept pace with hardware developments, says Ken Boyette, president of Logical Design Group Inc. And those users with debugged software for the Q bus refuse to give it up.

His company's answer is the VME-1120D, a single-board computer based on DEC's J-11 microprocessor that allows users to migrate to the higher-performance VMEbus without sacrificing their considerable software investment.

Intended primarily for robotics and industrial-control applications, the VME-1120D is touted as offering such advantages as higher system-bus bandwidth and support for multiple processors and shared resources. The board is designed to replace functions requiring several Q-bus boards with a single VMEbus board yet remain completely transparent to the operating software.

A big problem was to make the software think it is running on a Q bus. This was done by mapping all the devices with standard Q-bus addresses and vectors, Boyette says.

The 1120D's J-11 microprocessor, which operates at a 15-MHz clock rate and provides an on-chip memory-management unit for up to 4 megabytes, provides full software compatibility from the PDP-11/03 through the 11/70 systems. Boyette estimates that as much as 85% of a DEC user's software investment could be preserved using Logical's microcomputer board.

Linda Thacker, marketing director, says the Q-bus architecture currently holds about 30% of the market, and the VMEbus is expected to capture another 30% by 1987. "We're sitting on that sliced part of the pie" between the two, Boyette explains, adding that the 1120D is aimed at embedded Q-bus systems.

The 1120D VMEbus board incorporates all VMEbus system-control functions, plus Logical's Option 1 single-level bus arbiter, which allows the 1120D card to be the system's controller. A VMEbus interrupter provides support for multiprocessor systems. The interrupter is controlled by software and will generate a VMEbus interrupt in one of four VMEbus interrupt levels. In addition, an interrupt handler allows the J-11 to monitor up to four of the VMEbus' seven interrupt lines.

Logical has been beta-testing the 1120D at a major manufacuturer of precision automation equipment for the past nine months. Initial production began in early June, says Thacker, and currently delivery is from stock but may take up to four to six weeks. The boards sell for $2,400 each, but discounts are available for large volumes, she adds. A second version incorporating a lithium-battery backup is also available.

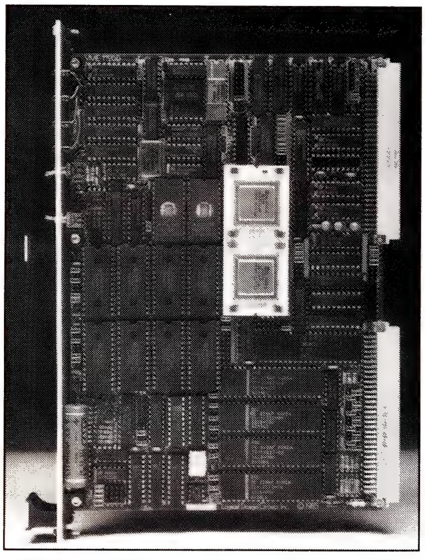
The 1120D's memory array includes eight 28-pin sockets that can accept byte-wide RAMs, ROMs, EPROMs, and EEPROMs in many combinations. Systems requiring nonvolatile storage can have up to 64-K bytes of battery-backed RAM on the card, and a maximum of 256-K bytes of EPROM is also possible. The company provides two memory sockets for installing standard DEC or custom bootstrap PROMs. Jumper options support the J-11's power-up modes.

In addition, the board uses a Zilog Z8036 Z-CIO counter-timer and parallel interface chip to provide 20 bidirectional I/O lines and three 16-bit counter-timers. Each of the counter-timers operates in retriggerable and one-shot modes that allow for frequency generation, pulse counting, and periodic event timing.

The VME-1120D is intended for "DEC-oriented people who need another hardware choice," Boyette says. The firm, founded by Boyette two and a half years ago, is now working on a follow-up product that will include ½ megabyte of dynamic RAM.

Oriented more toward PDP end users than OEMs, that product is tentatively scheduled for introduction at the end of November. *–George Leopold*

Logical Design Group Inc., 541 Pylon Dr.,
Raleigh, N.C., 27606.
Phone (919) 834-8827 [Circle 339]



PRESERVATION. Logical Design's VME-1120D runs DEC Q-bus-based software.

TAPE CONTROLLER FOR VMEBUS HANDLES 32 BITS

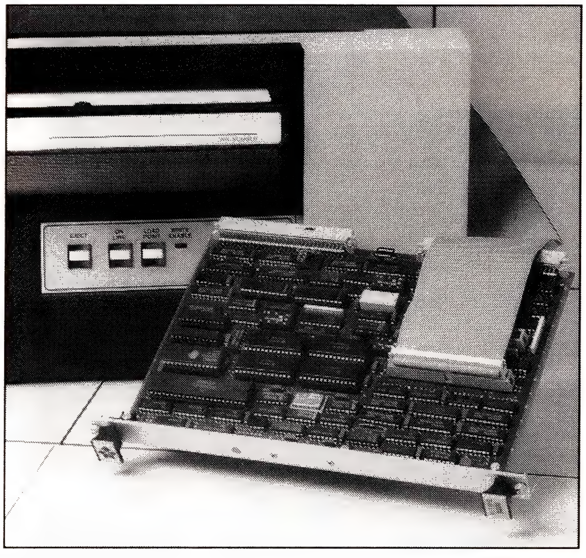
High-performance 32-bit tape controllers for the VMEbus are starting to stream onto the market, as equipment integrators ready new systems based on 32-bit 68020 microprocessors. Board manufacturer Interphase Corp. plans to be among the first manufacturers to offer a VMEbus tape controller that can perform full 32-bit data transfers without directly involving the system's CPU.

The V/Tape 3209 tape controller can handle up to eight ½-in., nine-track tape drives compatible with the formats set by Pertec Corp. The board, based on the Motorola Inc. 68008 8-bit microprocessor, can function as a bus master for programmable 8-, 16-, and 32-bit data transfers. Its addressing scheme can be set for transfers 16, 24, or 32 bits wide.

The board supports up to eight tape drives by means of two formatters, which split signals into four transports. Each transport attaches to a Pertec-compatible drive. The V/Tape 3209 contains as standard 8-K bytes of on-board buffering memory. Up to 128-K bytes of buffering is available as an option, says Tom Kent, Interphase's director of marketing.

The new controller uses some of the Unix-tailored, high-speed data-transfer firmware used in Interphase's V/SMD 3200 hard-disk controller, introduced earlier. The company has optimized the tape controller to work with the V/SMD 3200 disk controller. Both can transfer data between each other without directly involving the VMEbus system's host processor in direct-memory-access activities.

"Instead of passing the data transfers through the system memory twice, data goes one time across the bus from the



SOLO. Interphase's tape controller transfers data 32 bits at a time without the help of the system's central processing unit.

disk to the tape controller. That literally will cut the bus usage in half, speeding up the system," says Kent.

Interphase is working on a product that it says will also combine the high-performance disk controller and the tape unit on the same VMEbus board. The product will allow data transfers between disk and tape to occur on a private bus, off the main-system VMEbus, the company reports.

Aiming for volume deliveries in the fourth quarter, the company will offer the V/Tape 3209 controller for $1,750 each. *–J. Robert Lineback*

Interphase Corp., 2925 Merrell Rd., Dallas, Texas 75229.
Phone (214) 350-9000 [Circle 391]

PACIFIC MICRO PACKAGES KODAK DRIVE FOR IBM PCs

SAFETY. Backup is one job for Pacific's drive because it takes only four floppy disks to back up a 10-megabyte disk.

Not just another pretty face in the storage-subsystem pack, the Pelican 3.3 floppy-disk drive comes with a formatted capacity of 2.78 megabytes and a fast access time. The Pelican combines Eastman Kodak Co.'s 3.3-megabyte (unformatted) disk drive and Pacific Micro Systems' caching software. It is intended for use with IBM Corp. Personal Computers.

Caching—a feature that is becoming more popular in the world of personal computers—decreases the Pelican's average disk-access time tenfold, the company claims. Relying on the raw drive alone, access time would be 225 ms. Kodak's proprietary track-following servo system is sensitive enough to read a maximum of 192 tracks/in.; the average is 48 tracks/in. In addition, the system slices track-to-track seek time to as low as 3 ms.

"The Pelican 3.3 has been tested with many PC programs, and it works. It's genuinely compatible," says John Ferguson, president of Pacific Micro Systems. The Pelican comes with a plug-in interface card that allows overlapped operation with the PC's internal drives. Pacific's novel caching software borrows RAM from the IBM PC to buffer data to and from the disk, rather than using memory chips on the drive's controller card.

Pelican had a compelling reason to go with floppy disks when hard disks are dropping in price. "We already offer hard-disk density, and by using floppies, managers can remove sensitive data from the backup file in convenient 2.78-megabyte chunks," Ferguson says. Also, the high capacity means that backing up 10 megabytes of data from a Winchester disk drive requires only four Pelican disks. "We're complementing, not competing, with hard disks."

In addition to creating backup files, applications for the Pelican 3.3 include handling large data bases and spread sheets, word processors that use disk overlays, and program development.

The Pelican 3.3 is a freestanding unit with its own power supply, packaged in a heavy-duty aluminum enclosure measuring 2.5 by 6.5 by 13 in. "We feel that $795 is a good price for the caching feature plus a high-quality enclosure that occupies a small footprint," says sales manager William Wood.

The company is targeting value-added resellers and original-equipment manufacturers that work with the IBM PC. Pacific Micro has scheduled the first shipments of the Pelican 3.3 for early September. *–Ann Jacobs*

Pacific Micro Systems Inc., 160 Gate 5 Rd., Sausalito, Calif. 94965.
Phone (415) 331-2525 [Circle 390]

DATA-BASE MACHINE AIMS FOR THE OFFICE

The Relational Server RS310, from the maker of the Intelligent Database Machine family is intended for the office. The RS310, compatible with the company's larger IDM 500 series, sells for less than the earlier models.

Processing up to 10 simultaneous queries, the RS310 acts as a centralized server of data; it can provide up to 50 users on the network with the most current information and the dramatic performance that a specialized data-base system affords.

The RS310 uses a high-density 10-MHz data-base processor and 1 megabyte of RAM plus direct-access-memory circuitry. The system also comes with up to 170 megabytes of Winchester disk-drive storage and a 60-megabyte cartridge tape drive using the Small Computer Systems Interface standard.

The RS310 will be available in production quantities in the first quarter of 1986; a basic unit will cost $45,950.

Britton-Lee Inc., 14600 Winchester Blvd., Los Gatos, Calif. 95030.
Phone (408) 378-7000 [Circle 380]

MICROVAX II PACKAGED FOR OEMs

Systems developers—especially those working on industry-specific applications—can take advantage of the power of the Microvax II thanks to Quincy, an industrial-quality, Q-bus-based system. Quincy (model MSC 8808) provides a 10-slot, quad-size Q-bus backplane and 1 megabyte of RAM.

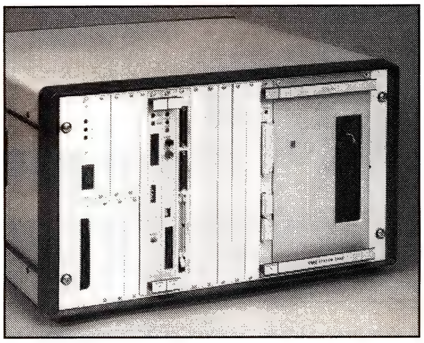
The system can expand to a total of 16 megabytes of RAM. Other features include a 200-W power supply and a 9-in. display monitor with keyboard. Up to three half-height 5¼-in. disk or tape drives can be mounted in the enclosure.

The units, in lots of 50, will sell to original-equipment manufacturers for $3,900 each. Delivery will begin this quarter.

Monolithic Systems Corp., 84 Inverness Circle E., Englewood, Colo. 80112.
Phone (303) 790-7400 [Circle 378]

VME SYSTEM USES 68010 PROCESSOR

The VMEsystem 1000 microcomputer is the first offering in Motorola's Open System, a line of computers that provides a logical starting point from which to tailor application-specific products.



The rack-mountable systems feature a VME chassis with card cage, a 400-W power supply, a 15-megabyte or 40-megabyte hard-disk drive, and a 1-megabyte floppy-disk drive.

The basic system, VMEsystem 1121, includes a 10-MHz 68010-based microprocessor module with a cache accelerator and 512-K bytes of RAM; a system controller that includes utilities, debugging, and diagnostic software; a combination disk-drive controller supporting up to two Winchesters and two floppy disks or four floppy disks; an I/O transition module; and a disk-interface module for connecting the disk drives to the controller. The multiuser system can run under either the Versados or System V/68 operating systems.

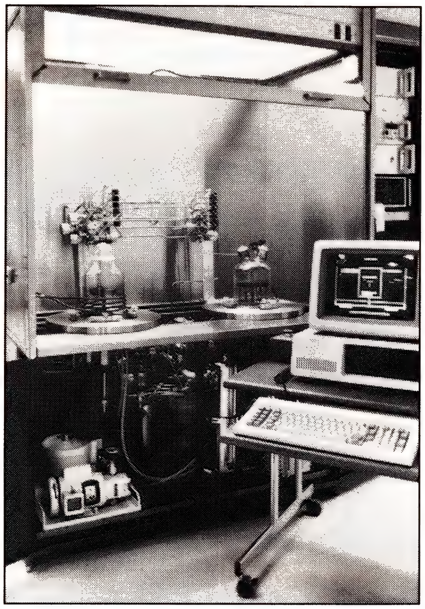
A basic system including a 650-K-byte floppy-disk drive, a 15-megabyte hard-disk drive, and the Versados software sells for $9,995 until October. Systems are available from stock.

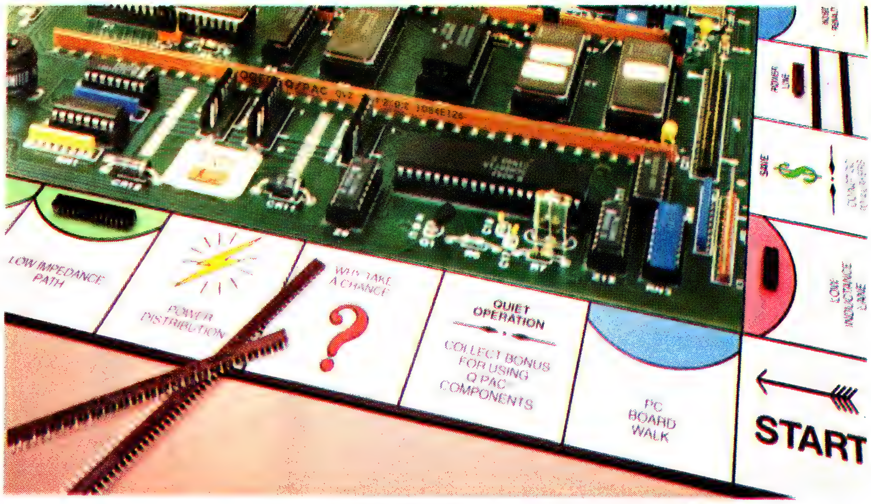
Motorola Semiconductors Products Inc., 725 S. Madison Dr., Tempe, Ariz. 85281. Phone (602) 994-6959 [Circle 379]

SYSTEM GROWS 3-IN. GaAs WAFERS

The GS 8000 system uses metal-organic vapor deposition to grow multiple wafers from gallium arsenide as well as other compound group III-V materials. The system can grow up to 40 3-in. wafers per day, which translates into 10,000 ICs, the firm says.

A typical GS 8000 system including gas-purification unit, gas-handling unit, growth chamber, vacuum system, computer controller, and exhaust system takes up just 4 by 8 ft of floor space. The company attributes the system's small size to the integrated valve block





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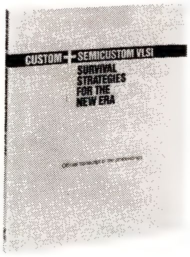


concept, where many system components such as the microflange, system lines, and pneumatic valves are built into one module.

The vapor pressures of the constituent materials are high enough to allow easy introduction into the GS 8000's chamber at normal atmospheric pressure when decomposition on a hot surface (pyrolysis) leads to an epitaxial deposit of the material on the substrate.

The growth chamber's ultrahigh-speed rotation ensures uniformity of thickness, doping, and composition. This produces the high levels of wafer purity required in optoelectronic and high-speed devices.

Full production systems will be available for delivery early in 1986. Prices will range from $250,000 to $1,000,000, depending upon requirements.

Emcore, 111 Corporate Blvd., South Plainfield, N.J. 07080.
Phone (201) 753-1311 [Circle 377]

VMEBUS CONTROLLERS BOW FOR PERIPHERALS

Two VMEbus peripheral controllers use custom very large-scale integrated circuits to provide high performance at a reasonable cost, according to their manufacturer.

Both the model 751 (a disk controller) and the 772 ½-in.-tape controller fully support the 32-bit VMEbus. The 751 supports interfaces for industry-standard storage-module-drive disk drives, including 2.4-megabyte/s models. The 772 supports formatted ½-in.-tape interfaces and tapes running at speeds from 12.5 to 200 in./s.

The 751 offers 8-, 16-, or 32-bit software-selectable transfer modes. It also has a separate 2-K-byte command buffer and an 8-K-byte first-in, first-out buffer. A command caching system is optimized for use with AT&T Bell Laboratories' Unix operating system.

Both boards are available now. Delivery takes from 90 to 120 days. Prices range from $1,600 to $2,700 for the 751, and from $1,100 to $1,800 for the 772, depending on the number of boards ordered.

Xylogics Inc., 144 Middlesex Tpke., Burlington, Mass. 01803.
Phone (617) 272-8140 [Circle 341]

RAM CARD WORKS WITH iLBX SYSTEM

The DSB-020EL, a Multibus RAM board with error-checking and -correction circutry, has an iLBX high-speed memory-bus interface that lets it work with all iLBX-compatible boards and systems. It gives users 1 or 2 megabytes of dynamic RAM; a single iLBX bus supports up to four of the boards.

Each board contains either 44 or 88 256-K-byte DRAMs. It has a large-scale-integration RAM controller, an LSI error-correction and -detection unit, and the dual Multibus and iLBX bus interface. The company says that memory refresh and error checking and correcting are performed on the board, transparent to the host.

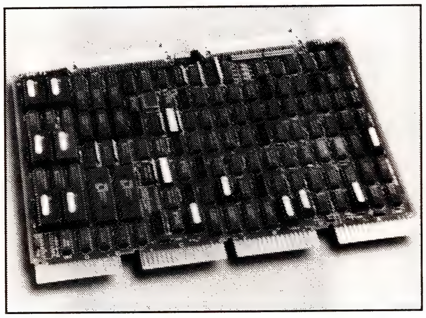
In quantities of 100, the 1-megabyte version sells for $1,084 and the 2-megabyte version for $1,796. The boards are available immediately.

Pascot Inc., Densan Division, 17981 Skypark Circle, Suite B, Irvine, Calif. 92714.
Phone (714) 261-5220 [Circle 343]

CARD EMULATES DEC's TS11 TAPE SYSTEM

Designed for use with Digital Equipment Corp.'s Q-bus products, the TC03 tape coupler connects the company's industry-standard tape drives with the DEC bus system. The single quad board also emulates DEC's TS11 tape system.

The board has three distinctive features, the company says: a block-mode direct-memory-access controller that improves Q-bus throughput for multiuser systems, a 900-K-byte/s transfer rate, and the ability to work simultaneously with a variety of tape drives.



Individual boards, which will be available in September, will sell for $1,600 apiece. Delivery will take 30 days after receipt of order.

Emulex Corp., 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, Calif. 92626.
Phone (714) 662-5600 [Circle 342]

CHIP UPGRADES 8088-BASED SYSTEMS

A processor-converter chip turns the signals of an 80286 processor into the equivalent signals of an 8088 processor, giving designers an inexpensive way to upgrade existing 8088-based systems. Dubbed the EL-286-88, the chip lets the 16-bit 80286 communicate with the less expensive peripheral IC designed for the slower 8-bit 8088 family.

The very large-scale integrated circuit translates data width, control signals, and timing. No software changes are necessary. The two processor clocks can run asynchronously, allowing the 80286 to run at the full 8-MHz rate while addressing peripherals designed for 4.77-MHz data rates.

Available in a 68-pin plastic leaded chip carrier, the EL-286-88 costs $44 each in quantities of 1,000 or more.

Edsun Laboratories Inc., 7 Sears Rd., Wayland, Mass. 01778.
Phone (617) 358-5667 [Circle 340]

CACHING SPEEDS UP DEC COMPUTER

A high-speed storage subsystem from Dataram uses caching to increase system throughput fivefold on a Digital Equipment Corp. PDP-11 or VAX computer. Its manufacturer also claims that the system takes only microseconds to access data.

The BS-207 attacks the data-transfer bottleneck between main memory and disk drive, responds at speeds comparable to system CPUs, and comes with capacities ranging from 2 to 256 megabytes of storage.

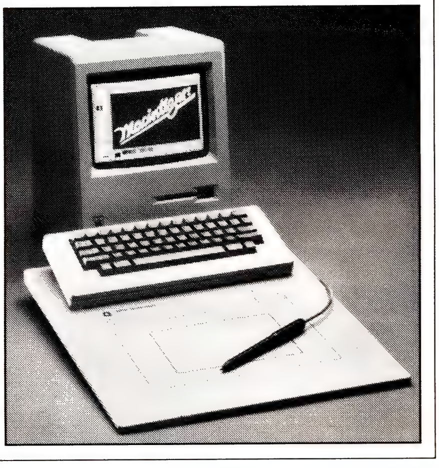
Price depends on capacity, and delivery takes 30 days.

Dataram Corp., Princeton Rd., Cranbury, N.J. 08512.
Phone (609) 799-0071 [Circle 355]

GRAPHICS TABLET CAN REPLACE MOUSE

The Macintizer, a graphic digitizing tablet, offers a replacement for the mouse on Apple Computer Inc.'s Macintosh by eliminating the mouse's flaws and expanding the computer's graphics capabilities, the tablet's maker says.

The Macintizer consists of an electronic tablet that works with a hand-held, pen-shaped stylus. The stylus is easier to use than the mouse because it makes more natural and precise drawing, the company says. Users can trace



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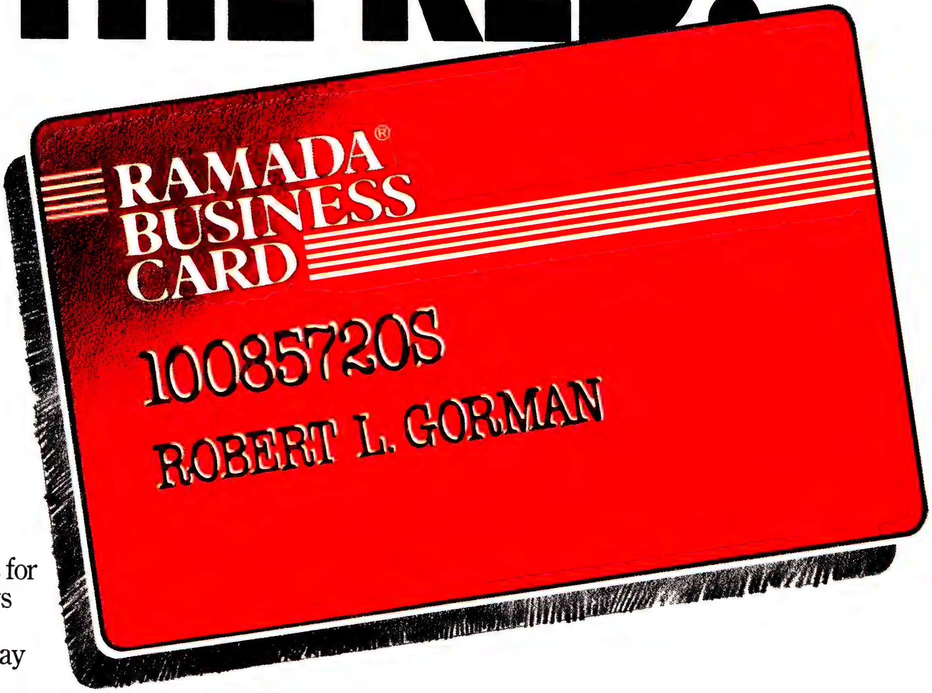

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Circle 55 on reader service card

maps, drawings, and other pictures directly onto the Macintosh screen.

The Macintizer, including the tablet, stylus, power supply, documentation, and all the connecting cables, sells for $599. The company will begin shipping the unit in August.

GTCO Corp., 1055 First St., Rockville, Md. 20850. Phone (301) 279-9550 [Circle 353]

PLOTTER MASTERS COMPLEX GRAPHICS

Producing high-resolution scientific graphics and complex plots at rates up to 17.7 in./s (measured diagonally), the model 6412 10-pen color plotter can draw on transparent film and various papers.

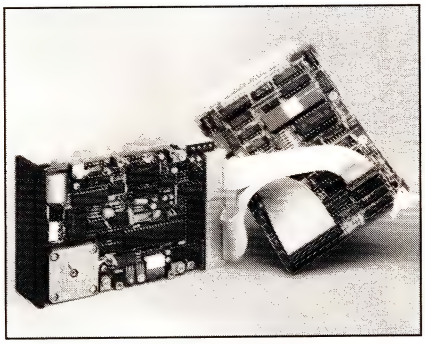
The plotter offers a selection of command functions including axis, hatching, foreign symbols, ellipses, curves, and curve fitting. The plotter sells for $2,795 and ships 90 days after receipt of order.

Numonics Corp., 418 Pierce St., Lansdale, Pa. 19446.
Phone (215) 362-2766 [Circle 354]

COMPACT DRIVE FITS IN CARD CAGE

A 10-megabyte Winchester disk drive subsystem fits entirely in a standard STD-bus card cage. The WIN-3-HDD-10 boasts a high-speed controller, an integrally mounted 3½-in. hard-disk drive, and standard software protocols for reading, writing, and formatting data.

The disk drive can be configured for up to 40 megabytes with the WIN-3-HDD-XX package, and it is suited for non-disk-based control applications, the company says. The 10-megabyte drive sells for $1,100. Delivery is within 30 days.



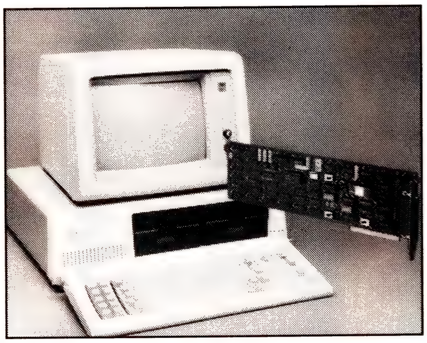
Computer Dynamics Inc., 105 S. Main St., Greer, S.C. 29651.
Phone (803) 877-7471 [Circle 352]

CARD LETS IBM PCs DO DATA CONVERSION

Dash-16, a plug-in data-acquisition board for the IBM Corp. Personal Computer, the PC/XT, PC AT, or compatibles, performs up to 50,000 12-bit analog-to-digital conversions per second. This suits the board to high-speed signal analysis, including fast Fourier transforms. The Dash-16 runs in two modes—16-channel single-ended input or eight-channel fully differential.

It also includes a multiplying 12-bit digital-to-analog converter with two channels. The converter can function as a programmable reference output, an output waveform generator, or a programmable attenuator. An on-board three-channel counter chip that generates or measures frequencies can also produce timing signals. Though the board includes switch-selectable input ranges, the user may install a resistor to provide the input range desired.

The utility software package, written in Basic, includes graphics and calibration routines; a Fortran-compatible library is optional. In lots of nine or less, the Dash-16 sells for $945 each and the For-16 Fortran library sells for $95. Delivery is from stock.

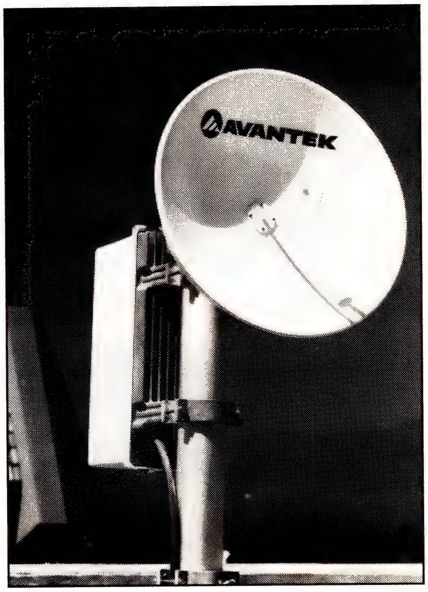


Metrabyte Corp., 254 Tosca Dr., Stoughton, Mass. 02072.
Phone (617) 344-1990 [Circle 361]

DIGITAL RADIO RUNS AT 23 GHZ

The DR23A digital microwave radio, which operates in the 23-GHz band, is designed primarily for use in low-density short-distance routes where frequency congestion prevents the use of lower-frequency bands.

The radio meets FCC specifications 21 and 94. It can transmit a single DS-1, DS-2, Conférence Européenne de Postes et Télécommunications 1, or CEPT 2 voice or data signal at 1.544, 6.312, 2.048, or 8.448 Mb/s. Housed in a weather-proof enclosure, the radio sells for under $10,000 and is available now.



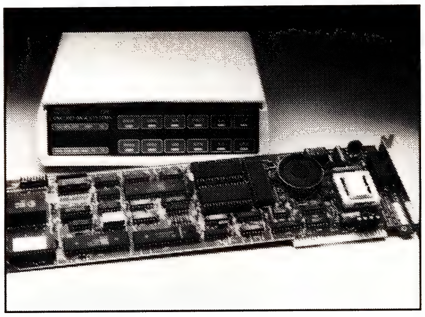
Avantek Inc., Telecommunications Marketing, 481 Cottonwood Dr., Milpitas, Calif. 95035. Phone (408) 943-4453 [Circle 357]

MODEM CAN PLUG IN OR STAND ALONE

Providing users a choice of 300-, 1,200-, or 2,400-bits/s performance, the 224 PC autodial modem card and the 224 Series II stand-alone autodial modem use standard communications protocols. With either unit, users can replace the standard processor chip to add new features.

The stand-alone Series II features full-speed buffering between the modem and the personal computer with which it is being used. It also can automatically adjust to the speed of incoming signals from a remote modem. It stores up to 10 phone numbers in nonvolatile memory, gives call-progress messages, and has a speaker with volume control.

The 224 PC card, fully compatible with IBM Corp.'s Personal Computer family, is a single-card internal modem identical in function to its Series II cousin. Command-driven by the PC keyboard, the modem includes full diagnostics. The Series II unit sells for $595 and



will be available in August; the 224 PC sells for $695 and is available now.

Concord Data Systems Inc., 303 Bear Hill Rd., Waltham, Mass. 02154.
Phone (617) 890-1394 [Circle 356]

COMPILER BRINGS STRUCTURE TO BASIC

A low-cost compiler brings speed and structured programming techniques to the Basic language. Quickbasic executes on IBM Corp. Personal Computers and compatible machines. The company claims the compiler performs 3 to 10 times faster than the Basic interpreter that comes as a standard feature on these computers.

Significant innovations to the Basic language have been added as well, the company points out. It has replaced line numbers with alphanumeric labels, facilitating statement referencing. Large software blocks can be broken down into subprograms, which can be compiled, separated, and then linked together at run time. Quickbasic supports local and global variables.

The compiler costs $99.

Microsoft Corp., 10700 Northup Way, Bellevue, Wash. 98009.
Phone (206) 828-8080 [Circle 366]

PACKAGE MERGES WORDS AND GRAPHICS

Dr. Halo II, the sequel to the Dr. Halo paint package, adds virtual paging to the original graphics software so users can build complete page layouts in hard copy by merging word-processing files with graphics. The manufacturer has also increased the list of peripherals Dr. Halo II supports to include Apple Computer Inc.'s Imagewriter and Hewlett-Packard Co.'s Laserjet printers, the IBM Corp. graphics adapter, and others.

Besides offering the features already present on Dr. Halo, the new package performs undo, scaling, additional error handling, and smart erasing. Error-handling features can also be customized. Current users of Dr. Halo can upgrade for $40. The price to new users is $139.95.

Media Cybernetics Inc., 7050 Carroll Ave., Takoma Park, Md. 20912.
Phone (301) 270-0240 [Circle 367]

UNIX USERS GET BUSINESS TOOLS

A package of three business software tools called Executive Assistant for the AT&T Co. 7300 computer and other Unix-based systems can be used either in conjunction with the company's Modtech Big 8 Accountant Series package or

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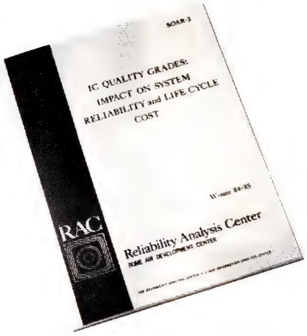
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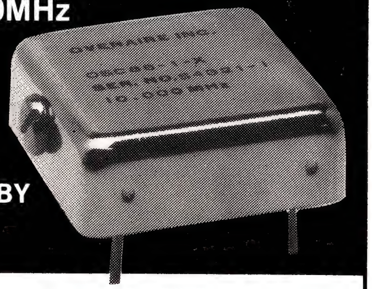

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alone as individual modules.

The Sunscript word processor offers 99 edit commands and automatic formatting. The Suncalc spreadsheet has field editing and full math and statistical functions. The Sundata file manager is a fully integrated report writer that generates reports using data from Big 8 or user-created files, with full update capabilities between files. The retail price of Executive Assistant is $895.

Modern Technologies International Inc., 656 Bair Island Rd., Suite 302, Redwood City, Calif. 94063.
Phone (415) 367-6855 [Circle 369]

SOFTWARE EXAMINES DOS APPLICATIONS

Through a package called X-View 86, software engineers can observe the internal operation of DOS application software. X-View 86 is a software analyzer, similar to a debugging program, but it allows the user to obtain previously unavailable technical information.

Using X-View 86, the engineer can interrupt an application program on any processor-I/O access, on any interrupt instruction, when its execution reaches a specified address, and whenever the program uses a specified memory location.

Including the disk, documentation, and technical support through the Byte Information Exchange (BIX) electronic mailbox, X-View 86 costs $59.95.

McGraw-Hill Inc., 8111 LBJ Freeway, Dallas, Texas 75251. Phone (800) 233-8439; in Texas, (800) 233-8439 [Circle 368]

LOADED-BOARD TESTER GROWS TO 2,048 NODES

An in-circuit test system for loaded pc boards, including mixed analog and digital configurations, starts out with 320 test nodes but can expand to 2,048 in increments of 32 nodes.

The menu-driven DP-510Z performs a series of component tests that compare the unit under test with data stored in memory from a known-good board. If a component fails, the system retests the board automatically.

The DP-510Z also performs quadrature testing, measuring reactive circuits by comparing both the real and imaginary values of a particular component test—an unusual feature in this price range, according to the manufacturer.

Available with either pneumatic or vacuum-operated fixturing, the DP-510Z comes in a ruggedly built roll-around console. The console contains the measurement electronics, control circuits, a computer, dual disk drives, a 24-column strip printer, and a cathode-ray tube. This basic system, including software and installation, sells for $39,900. Delivery is from stock, four weeks from receipt of order.

Datapower Inc., Department TIC, 3328 W. First St., Santa Ana, Calif. 92703.
Phone (714) 775-2000 [Circle 364]

DYNAMIC-RAM TESTER RUNS AT 100 MHz

Dynatest, a dynamic-RAM tester, generates high-speed patterns from its 100-MHz timing engine in 64 steps, each 10 ns long. Twelve-bit row-address-strobe and column-address-strobe counters are ready for the megabit DRAMs of the future, and Dynatest can be upgraded now to test EPROMs, EEPROMs, PROMs, and programmable logic devices. A built-in computer handles files and stores data as well as communication with the display terminal, a printer, or an automatic IC handler. Test patterns in the library are either standard or user-generated.

Priced at $10,000, Dynatest includes a terminal, disk operating system, built-in disk drive, and Dynasoft, the test-program software pattern editor plus utilities. The system is now going through beta-site tests; delivery takes 90 days.

Logical Devices Inc., 1321-E N.W. 65th Pl., Fort Lauderdale, Fla. 33309.
Phone (305) 974-0967 [Circle 363]

PLAs BOAST 25-NS PROPAGATION DELAYS

Four 20-input programmable logic arrays have maximum I/O propagation delays of 25 ns. The manufacturer says the chips can replace more small- and medium-scale integrated circuits and perform more complex functions than earlier 20-pin PLAs.

The parts, designated the PAL20L8A, -20R8A, -20R6A, and -20R4A, come in thin 24-pin plastic or ceramic thin DIPs or 28-pin plastic leaded chip carriers. In 100-piece quantities, the chips cost $6 in plastic, $7.25 in ceramic, and $6.90 in chip carriers.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051.
Phone (408) 721-5000 [Circle 350]

LOGIC DEVICES DRAW 1 MICROAMP

Compatible with CMOS outputs, two transparent latch chips and two flip-flops can be made compatible with large-scale TTL outputs by adding pull-up resistors.

The chips meet or exceed Joint Electron Device Engineering Council Standard No. 7, and all four draw just 1 μA of current and have an input-voltage range of 2 V to 6 V. Each can drive 15 low-power Schottky TTL load outputs. The chips are available in either the 54 series, which runs between –55°C and +125°C, or the 74 series, which operates from –40°C to +85°C. Pricing ranges from $2.62 to $4.71, depending on packaging and quantity ordered.

Motorola Inc., MOS Logic and Analog Integrated Circuits Division, P.O. Box 6000, Austin, Texas 78762.
Phone (512) 928-7944 [Circle 351]

SERVER LINKS VAX-11 COMPUTERS

Micom's INTS16/VMS functions as an integrated-network terminal server to a host Digital Equipment Corp. VAX-11/725, /730, or /750 computer. The hardware and software package multiplexes 16 terminal channels onto a single Ethernet local-area network. Users needing more than 16 channels can cascade up to four terminal servers, for a total of 64 channels.

Because the INTS16/VMS is functionally identical to Micom's stand-alone NTS10 terminal server, asynchronous peripheral devices—printers, modems, and so forth—connected to NTS10 units can communicate over an Ethernet and access VAX systems through INTS16/VMS hardware and software.

The INTS16/VMS operates independently of its host under control of its 16-bit microprocessor; DEC's VMS operating system needs no modification to run the server's software. Host-resident services include a port driver that consolidates terminal traffic, reducing host interruptions. The INTS16/VMS terminal server sells for $3,490. Delivery takes 30 days after receipt of order.

Micom Systems Inc., 4100 Los Angeles Ave., Simi Valley, Calif. 93063.
Phone (805) 583-8600 [Circle 365]

COMPONENTS

CLOCK OSCILLATOR DRAWS ONLY 3 mA

A low-cost clock oscillator draws less than 3 mA of current, making it ideal for battery-operated equipment, its manufacturer says. The KXO-CL offers a frequency range of 50 Hz to 8 MHz and has a standard 100 parts-per-million initial-frequency stability. A 50-ppm version is also available.

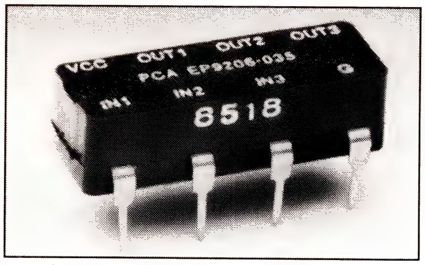
Hermetically sealed, the part comes in a welded, all-metal package to protect it from radio-frequency interference. It sells for $3 each in quantities of 10,000.

Kyocera International Inc., Electronic Components Group, 11425 Sorrento Valley Rd., San Diego, Calif. 92138 [Circle 345]

SMALL PACKAGE HOLDS 3 DELAY LINES

Containing three separate TTL-compatible delay lines, the EP9206 delay-line series offers delay times of from 5 ns to 250 ns with a resolution of ±2 ns.

The parts, intended for applications requiring high delay stability, fast rise time, and no jitter, feature a Schottky TTL I/O buffer with each delay line. The output buffer can drive a fanout of 10 Schottky loads. Packaged in transfer-molded, 14-pin DIPs, the parts sell for $3.40 each in 1,000-unit orders. Delivery is stock to six weeks.



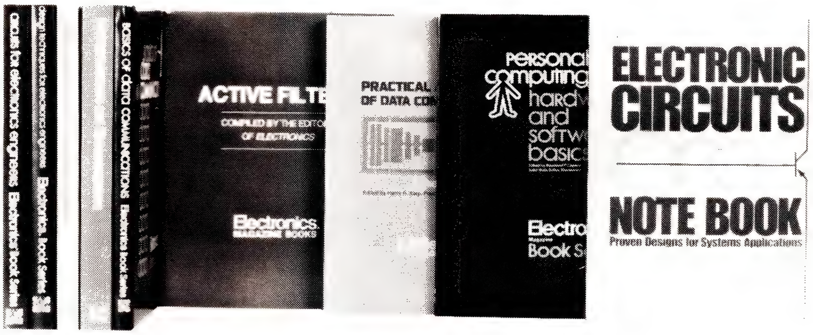
PCA Electronics Inc., 16799 Schoenborn St., Sepulveda, Calif. 91343.
Phone (818) 892-0761 [Circle 346]

TWIN RELAY CIRCUITS REDUCE REDUNDANCY

Twin solid-state relays use back-to-back silicon-controlled-rectifier outputs and are totally isolated from each other and the heat sink. Both relay circuits in the package are random turn-on types, offering quick turn-on, the company says.

Two versions are available: the 25DR2D, which handles resistive loads up to 25 A with each of its independent SSR sections, and the 40DR2D, which handles up to 40 A with each section. The two relays can work in parallel or separately. Prices start at under $20.

Silicon Power Cube Corp., 2725 Seaboard La., Long Beach, Calif. 90805.
Phone (213) 634-9390 [Circle 347]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Articles from *Electronics* include sections on lithography and processing for integrated circuits, thick- and thin-film hybrids, printed-circuit-board technology, automatic wiring technology, IC packages and connectors, environmental factors affecting interconnections and packages, computer-aided design, and automatic testing. Pub. 1980, 321 pages, softcover.
Order No. R-927, $15.95.

Microprocessors and Microcomputers: One-chip Controllers to High-end Systems
Practical orientation to all aspects of microprocessors and microcomputers in 95 articles from *Electronics* covering low-end microcontrollers, mid-range microprocessors, high-performance 16-bit microprocessors, high-speed bipolar processors, peripheral support chips, signal processors, board-level microcomputers, software and applications. Pub. 1980, 482 pages, softcover.
Order No. R-011, $18.95.

Basics of Data Communications
This compilation of essential articles from *Data Communications* magazine includes chapters on terminals, acoustic couplers and modems, communications processors, networking, channel performance, data link controls, network diagnostics, interfaces, and regulations and policy. Pub. 1976, 303 pages, softcover.
Order No. R-608, $15.95.

Practical Applications of Data Communications
Selected articles from *Data Communications* magazine cover architecture and protocols, data-link performance, distributed data processing, software, data security, testing and diagnostics, communications processors, and digitized-voice and data-plus-voice. Pub. 1980, 424 pages, softcover.
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VAX. "VAX Software for the OEM" covers all VAX operating systems, including VMS, MicroVMS, Ultrix, and Vaxeln. The 16-page brochure also covers languages, application packages, programming-development tools, graphics software, and more. The booklet "VAX Software—Abbreviated Descriptions" lists names and brief descriptions of the most current VAX software. Both are free from Digital Equipment Corp., 77 Reed Rd., Hudson, Mass. 01749. Phone (617) 568-4000. [Circle reader service number 422]

POWER TUBES. A 16-page catalog details Westinghouse Electric Corp.'s line of high-vacuum amplifiers (triodes), high-vacuum pulse tubes (triodes), and high-vacuum diodes. These are often used in industry, the military, radar, broadcasting, and communications. For a copy of "Power Tubes: Quick Reference Guide," catalog B9431B, write to the company's Industrial and Government Tube Division, Horseheads, N.Y. 14845, or call (607) 796-3360. [Circle 423]

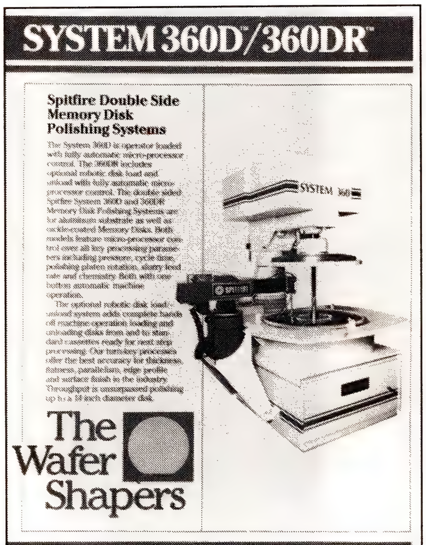
DISCRIMINATORS. A free data sheet describes the series 401 frequency-modulation telemetry discriminators, designed to linearly convert the FM subcarrier signals of all Inter-Range Instrumentation Group telemetry bands 1 to 18 and A to E to a proportional voltage. Recommended by the manufacturer for use in military, industrial, and research data-recording systems, the devices operate in the range from −20°C to +75°C. For copies of the data sheet, write to Solid State Electronics Corp., 18646 Parthenia St., Northridge, Calif. 91324. Phone (818) 993-8257. [Circle 424]

RETROFIT. An application note, "Maxcap Double Layer Capacitor: Retrofit for Data Retention," describes how Maxcap double-layer capacitors provide simple retrofitting for CMOS data-memory retention. Maxcaps feature very fast recharge time, easy interface, and nearly unlimited life. Unlike batteries, they are nontoxic and pose no disposal problems. Request Form A-14037, available without charge, from Sohio Engineered Materials Co., Semiconductor Division, Department M3, P.O. Box 664, Niagara Falls, N.Y. 14302, or call the company at (716) 278-3954. [Circle 425]

PROGRAMMERS. Free brochures describe two EPROM programmers, the models 8407 and 8402, which can gang-program memories to 256-K bytes. In addition, the 8407 offers an emulator mode for prototype development of 24- or 28-pin devices, and the 8402 offers alternate loading: the upper and lower sections, which have separate power supplies, are completely independent. The brochures can be ordered from Sherman Pirkle Inc. by calling (617) 861-6688. The mailing address is 782 Massachusetts Ave., Lexington, Mass. 02173. [Circle 426]

WORK STATIONS. Sun Microsystems Inc. has published the first bound edition of its catalog of software and add-on hardware for its line of work stations. Examples of some of the products listed are Geometrical Modelling System for solids modeling; Design Capture Toolkit, software for circuit design; Design Oriented Graphics System, a design-oriented two-dimensional drafting and design system; and Hieroglyph, a document-production package. The products are offered under Catalyst, Sun's third-party-vendor arrangement. Address requests for this free material to 2550 Garcia Ave., Mountain View, Calif. 94043, or call (415) 960-1300. [Circle 427]

DISK POLISHER. A brochure from Kayex Corp. describes memory-disk polishing systems for aluminum-substrate and nickel-coated memory disks. The system 360D is operator-loaded; the system 360DR, with optional robotic disk load, creates completely hands-off machine operation. Users control both systems by pushing a single button to initiate microprocessor control over pressure, cycle time, and other key parameters of the polishing process. The literature is free. Call (716) 235-2524 or write to Kayex at 1000 Millstead Way, Rochester, N.Y. 14624. [Circle 421]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PICK. The International Data Base Management Association (IDBMA), a trade organization for the promotion of the Pick operating system in office environments, has published the fourth edition of the annual *IDBMA Application Software Directory*. The 253-page catalog features some 620 application software packages in 93 categories. It also lists 58 consultants specializing in Pick-based computer systems. An international section is also included. Priced at $30 plus $3.50 for shipping and handling (California residents must add sales tax), the catalog is available from IDBMA at 9740 Appaloosa Rd., San Diego, Calif. 92131. [Circle 428]

IMAGE SENSING. "Image Sensing Products" describes EG&G Reticon's linear, area, and circular photodiode arrays, X-ray and image sensors, and more. Widely used in applications such as character and page scanning, size and position monitoring, and spectroscopy, these products are also available as custom image sensors and evaluation boards. Application notes and reprints appear throughout the data book. Call (408) 738-4266 for a free copy, or write to EG&G Reticon, 345 Potrero Ave., Sunnyvale, Calif. 94086. [Circle 429]

T-1. A 32-page brochure describes the Infostream series of high-speed time-division multiplexers for use in either domestic or international networks. Included are complete specifications and detailed explanations of control features with which users can set up and monitor even the most complicated networks. The brochure is free from Infotron Systems Corp., Cherry Hill Industrial Center, Cherry Hill, N.J. 08003, or call (609) 424-9400. [Circle 430]

ADA. A newly released version of *Lessons on Ada*, a 50-hour computer-aided instructional course on the high-level language Ada, now runs on Digital Equipment Corp. VAX computers. It had been available only for the IBM Corp. Personal Computer and its compatibles. The two-part course—presenting core concepts and introducing advanced concepts—is described in a free brochure from Alsys Inc., 1432 Main St., Waltham, Mass. 02154. Phone (617) 890-0030. [Circle 431]

SIMULATION PROGRAM. A four-page application note that presents a Basic program for calculating an analog-to-digital converter's signal-to-noise ratio and harmonic distortion is available from ILC Data Device Corp. The authors of the note also illustrate a typical signal-to-noise measurement setup with waveform comparisons. Free copies of "A/D Simulation Program Predicts Signal-to-Noise Ratio" are distributed by the Marketing Department. Call (516) 567-5600 or write to the company at 105 Wilbur Pl., Bohemia, N.Y. 11716. [Circle 432]

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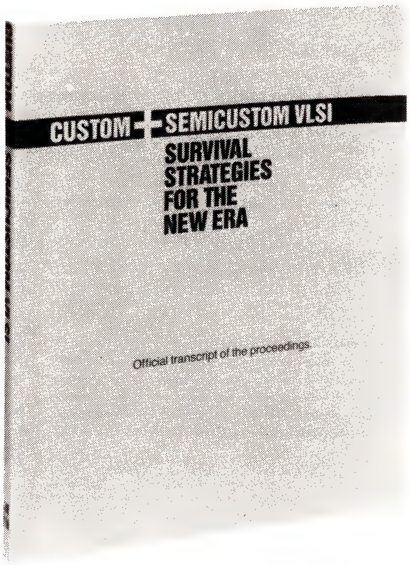
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South? Technical/Professional Placement Network-Fee paid. Murkett Associates, Box 527, Montgomery, AL 36101.

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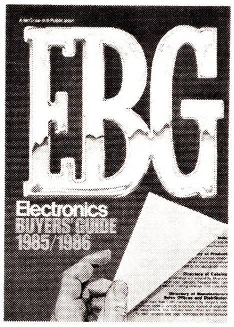

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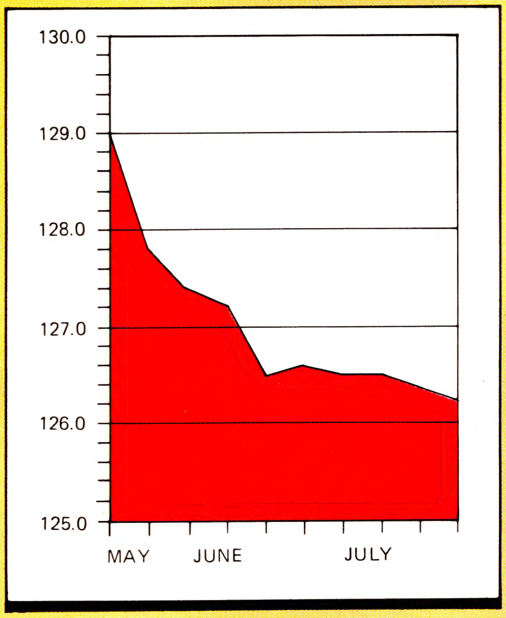
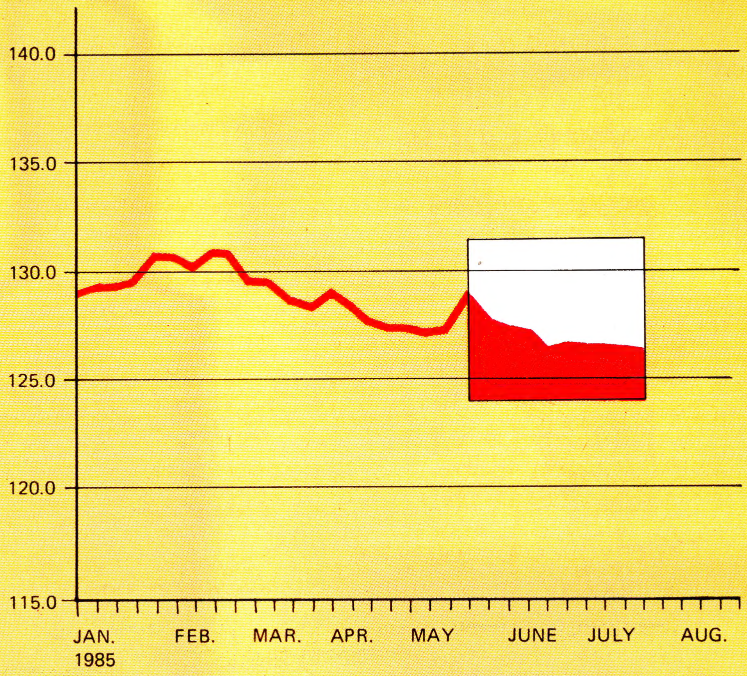
ELECTRONICS INDEX





THIS WEEK = 126.2
LAST WEEK = 126.4
YEAR AGO = 128.9
1982 = 100.0

The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. ELECTRONICS PRODUCTION INDEX

	May 1985	April 1985	May 1984
Office and data-processing equipment	274.2	276.3	254.0
Communications equipment	221.1	219.8	198.3
Radio and TV equipment	144.2	151.2	156.2
Electronic and electrical instruments	139.6	138.5	133.7
Components	262.2	265.8	286.3

U. S. ELECTRONICS COMPONENT-PRODUCER PRICE INDEX (1967 = 100)

	June 1985	May 1985	June 1984
Digital bipolar integrated circuits	60.0	59.8	63.2
Digital MOS ICs	37.5	39.8	42.9
Linear ICs	62.3	63.1	64.1
Capacitors	190.2	190.0	190.1
Resistors	189.1	188.7	181.8
Relays	312.6	312.6	319.1
Connectors	234.5	234.1	228.2

Yet another decline in the production of electronics equipment squeezed the *Electronics* Index down a notch in the latest week. Though the decline did not hit all industry sectors, as in previous months, it was severe enough to push overall production down 1%. Hardest hit were the makers of television and radio equipment, which saw output fall nearly 5%. Components companies and manufacturers of office and computer equipment suffered less dramatic drops, with production output declining 0.6% and 0.8%, respectively.

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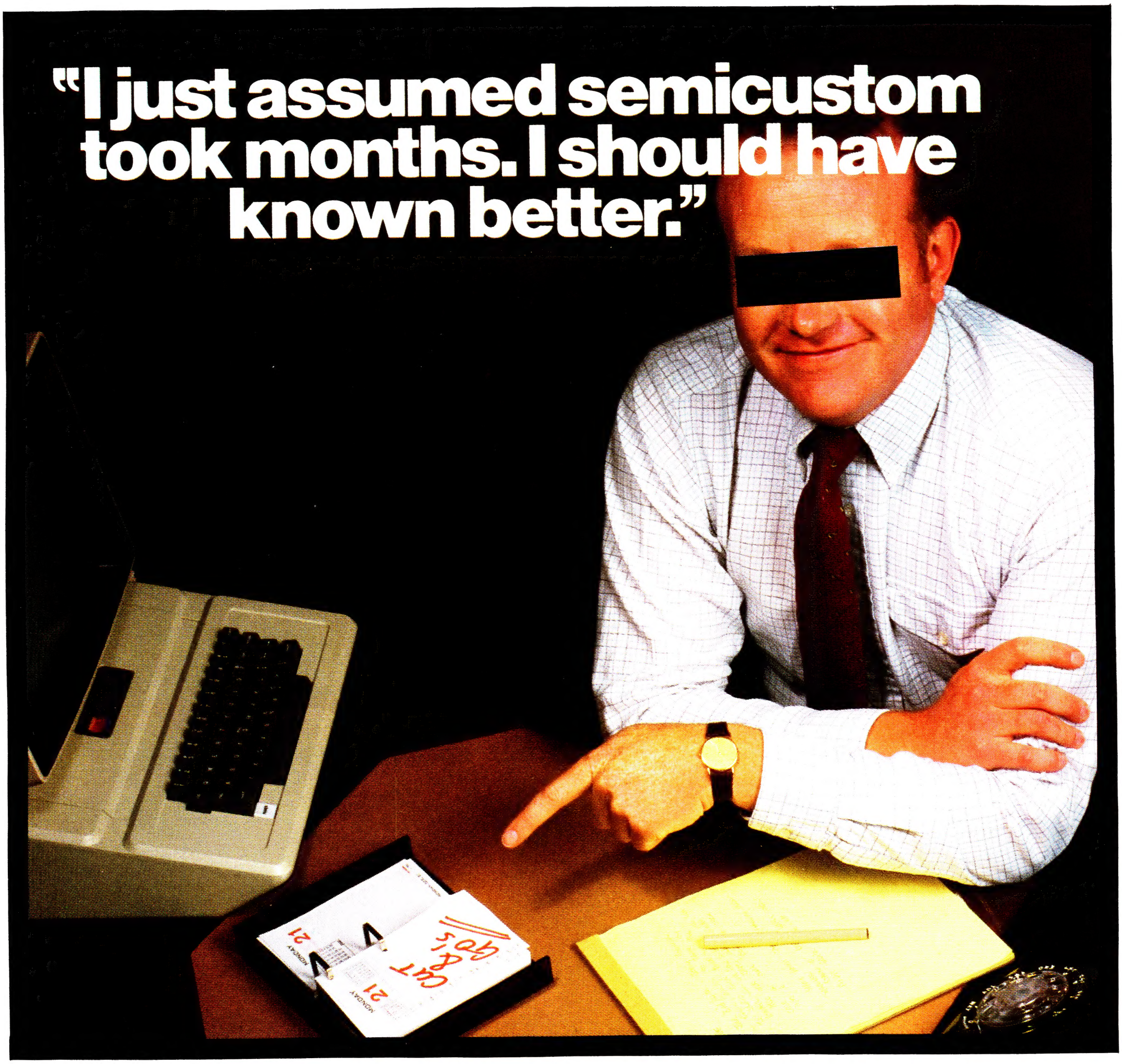
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